PRINCIPLES

OF

LITHOTRITY.

LONDON:
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.

PRINCIPLES J.S. 1832

OF

LITHOTRITY;

OR,

A TREATISE

ON

THE ART OF EXTRACTING THE STONE WITHOUT INCISION.

BY

BARON HEURTELOUP,

DOCTOR OF THE FACULTY OF MEDICINE, PARIS.

ILLUSTRATED WITH PLATES OF THE INSTRUMENTS USED IN LITHOTRITY.

"The object is not now to practise Lithotrity, but to practise it well."—PREFACE.

LONDON:

WHITTAKER, TREACHER, AND CO.,

AVE-MARIA-LANE.

1831.

ADVERTISEMENT.

But slightly acquainted with the English language, and desiring, nevertheless, to place my book in the hands of all the surgeons of this country, I have necessarily been indebted to the kindness of several friends for the translation. It will not be surprising, therefore, if the reader finds the parts which compose it written in different styles. Perhaps, also, some Gallicisms and French-turned phrases may be found; but it is only right that I should take these to myself—for I have begged my friends to sacrifice the purity of the language to the sense.

À MONSIEUR LE PRESIDENT

ET

A MESSIEURS LES MEMBRES

DU

COLLEGE ROYAL DES CHIRURGIENS

DE LONDRES.

MESSIEURS,

Après avoir consacré sept années d'un travail assidu et pénible au perfectionnement de la Lithotritie, je sens qu'il est de mon devoir de faire tout ce qui dépend de moi pour répandre les bienfaits de cette invention.

C'est pour remplir ce devoir, que je suis venu en Angleterre la mettre en pratique sous vos yeux, afin de vous en faire apprécier tout l'avantage, et d'attirer sur elle votre intérêt et vos méditations.

En prenant la liberté de vous dédier cette édition Anglaise, je crois marcher vers ce but important.

Accueillez la donc avec bonté et indulgence, et voyez dans ma démarche une preuve de mon profond respect pour votre honorable et savante société, et de ma sincère reconnoissance pour ceux d'entre vous, qui, par amour du bien public, ont accordé à un étranger leur aide et leur protection.

BARON HEURTELOUP.

No. 1, Vere Street, Cavendish Square.

TO THE

PRESIDENT AND MEMBERS

OF THE

ROYAL COLLEGE OF SURGEONS,

LONDON.

GENTLEMEN,

After having devoted seven years to an arduous and difficult study for the improvement of Lithotrity, I feel it my duty to do all in my power towards extending the beneficial results of this invention.

It is to fulfil this duty that I have come to England to practise it under your eyes, in order that all its advantages may be appreciated, and that it may attract your interest and attention.

In taking the liberty of dedicating this English edition to you, I hope to further this important object.

Receive it then with kindness and indulgence, and consider it as a mark of my profound respect for your enlightened body, and my sincere gratitude to those among you, who, from a disinterested regard for the public welfare, have accorded to a foreigner their assistance and protection.

BARON HEURTELOUP.

No. 1, Vere Street, Cavendish Square.

CONTENTS.

PREFACE.

We hear it said so commonly, that a book has been published too soon, and that the author has not sufficiently considered the different bearings of his subject, that I confess I do not feel the same confidence in publishing this Treatise, which those who have hitherto written on the art of Lithotrity seem to have experienced. It is, on the contrary, rather with a feeling of regret that I lay it before the public; I should have preferred delaying it yet some time, not only that it might be presented in a still more complete and perfect state, but also, that general opinion on the new art of which I speak, might be more matured. I have not written, however, without great reflection, which, I trust, the following pages will render evident.

Having commenced my labours in lithotrity so soon after its birth, it was necessary to wait, before I wrote on this new means of treating the stone, until the first steps that were adopted were tolerably understood and known; for the change that may be effected in any thing, can only be understood by comparison—and all comparison requires a previous knowledge of the objects compared.

I have long ago pointed out the faults and defective action of the first means adopted in lithotrity. But it was also necessary that experience should give its weight to my words, in order to make it palpable and evident to every one, that lithotrity was yet in its infancy.

Experience has now furnished its proofs; the "perce-pierre" and its inefficiency are known, and it is no longer a matter of doubt to any one, and especially to surgeons who have employed it, that the interests of science claimed great and important changes.

It is this acknowledged truth, such as it is, without the commentaries which the consi-

deration of cases, where the "perce-pierre" has been unsuccessfully employed might furnish:—It is this fact which authorises me to propose the new means of performing the operation, which will be found in this work.*

During seven years I have laboured to give

---

* We might give numerous examples of the inefficiency of the "perce-pierre," and even of its danger in some cases; but we should be obliged to draw our proofs from facts which do not belong to ourselves, and this we are unwilling to do. However, as any thing which is published is committed to the public inspection and consideration, I wrote, in 1827, a review* of the cases presented by M. Civiale in his work, from which it resulted that lithotrity, as practised with the "perce-pierre" alone, was very deficient in many respects; besides reviewing the cases, I support Dr. Gruithuisen in his pretensions to the invention of the *method* of breaking up calculi in the bladder, and defend the rights of M. Leroy (D'Etiolle) to the invention of the *means*, employed at present by M. Civiale to perform lithotrity. The Academy of Sciences, by recognizing, in its subsequent decisions, these two medical gentlemen as the inventors, and by conferring on them honourable rewards, proves that the reflections which I made in my letter were not without foundation.

My letter to the Academy of Sciences also contains a translation of Dr. Gruithuisen's valuable and important Mémoire, published by this physician in the Medical Journal of Saltzbourg, in the month of March, 1813.

* This review is written in a letter addressed to the Academy of Sciences, and contains a critical examination of M. Civiale's work, entitled "De la Lithotritie, ou broiement de la pierre dans la vessie," also a correct estimation of the facts presented by this gentleman. This pamphlet may be procured at Balliere's, 219, Regent Street.

to lithotrity a more scientific form, by substituting for the exclusive and empirical employment of a single instrument the rational and accurately-adjusted application of several, forming a combined system, by which each one shall be fitted to the form and size of the stone or fragment to be destroyed.

This is the object I have had in view throughout my labours, and the problem it formed, is that which I have sought to solve.

Desiring to present a series of combinations established on this basis, it will be understood that long application on my part has been required. It will also be conceived that I could not, without misleading or giving a false idea, present them to the public in parts; and in this necessity of giving them the most complete form possible, will be found the cause of the delay that has taken place before I could fulfil the honourable condition* which the Institute imposed, when that learned body

* When the first prize of surgery was awarded to me, the Institute expressed a wish that I should describe and make known my instruments as soon as possible.

judged some of my combinations worthy of several of their highest rewards.*

I have observed with regret, that by some this delay, whose object was so legitimate, has been unfavourably construed; and not only this, but that some have profited by it, to indulge in some unfounded speculations; to which it is necessary I should advert.

First: I am ignorant from what motive it has been asserted in some books, that I condemned the instrument termed the "perce-pierre." I am not aware of having in any place either said or written, that this instrument was so defective that it ought to be

* The Academy of Sciences conferred on me, the 5th March, 1826, a pecuniary reward for writing a Mémoire *on the extraction of calculi by the urethra*, which I presented to them, and for having, according to their own expressions, *ingeniously perfected the instruments adapted to lithotrity*; and, in the year 1827, they awarded to me the first prize of surgery, for the *important improvements and ingenious instruments which I had, in the course of that year, added to lithotrity.*

In 1826, the Academy of Sciences alluded to my *rectangular bed, fixed point*, and "*évideur à forceps*," which, although imperfect at that period, attracted the attention of the Institute; in 1827, the learned gentlemen alluded to the perfections which I had made in the "évideur à forceps," and to the invention of the "brise-coque."

banished from the art. I have said it was *inefficient*, and I repeat it, because it is essentially true, and requires no further demonstration than the simple description of its action :—It makes only a single hole, of three lines and a half in diameter, in the stone; this alone condemns it: notwithstanding which, it is not the less true that numerous successful operations have been performed with this combination, which assigns to it a certain rank amongst lithotritic agents. If I have been described as doing it an injustice, it is probably with the wish to blame me, and create an element of discussion. I would further observe on this subject, that it is unreasonable to imagine that I entertain such ideas of exclusion, when I was the second surgeon who employed this instrument, and the second *who effected cures by it*.

They have, therefore, been unjust towards me, and so much the more so, that, in accusing me of pronouncing the exclusion of the "perce-pierre," in the face of examples of successful results obtained with this instru-

ment by others and myself, they accuse me of inconsistency, and a want of good faith. However, it will be seen that, in proportion as the science advances, the instrument alluded to loses its importance, and its inefficiency becomes more and more palpable. The fact of patients having been cured by its aid, does not make it evident that they were cured by the concentration of all that could insure success; neither does it prove that the great number who have not been cured, might not have received the desired relief by a more perfect apparatus.

In the hope of being useful, and also with the intention of answering all these unfavourable insinuations, I have given in my work a place to this instrument; for, although published by M. Civiale, he has merely given the drawing of it, without adding the details which are necessary to enable the surgeon to employ it; consequently, till now it has not formed a component part of the science.

It is an inadvertence which I shall remedy with the greater pleasure, as I shall thus ac-

quire the right of placing it in my book, especially as I have effected some changes in it, which I believe advantageous. In my opinion, the publishing the means of employing an instrument, is adding to the knowledge of its construction a very indispensable part. I am therefore indebted to the practitioners who have preceded me, for the satisfaction I feel in fulfilling so important a duty.*

If lithotrity, already known so many years, has not been more frequently practised by surgeons in easy cases, and such as the instruments were well calculated to relieve, it is because rules were wanting. I hope that,

* It is in no way my intention to encroach upon the right which the authors of the "perce-pierre" have, to give their manner of employing it. I only give it because they have been silent on this important head. They have yet time to explain its details as regards their operations, for I shall only give my ideas on this subject when I publish the second part of my work—the *Practical Part.* As I entertain opinions of my own respecting the mode of employing the "perce-pierre," these gentlemen would oblige me much, by publishing the results of their experience on this subject. If they fail to do so, should I not be authorised, in my turn, to express surprise that the rewards they have received from the Institute, should have turned so little to the profit of the science and humanity?

when clearly and methodically laid down, lithotrity, in simple cases at least, will lose, in the eyes of medical and scientific men, the appearance of extreme difficulty, with which some have invested it.

As I said in the beginning of this Introduction, my labours in lithotrity have continued during the last seven years, and, as they advanced, I submitted them to the judgment of the Institute. I have also been in the habit of demonstrating, in the public hospitals, the alterations and additions which study and experience suggested to me as improvements. It will not be a matter of surprise, then, that some surgeons may have thought fit to borrow from me; I might, as each of these borrowed combinations were published without any acknowledgment, as there ought to have been, of the source from whence they were drawn, have made known my own claims. But I have been prevented by two reasons; the first is, that these loans, having been taken in a partial and imperfect manner, have

been of no service to the borrowers, and, consequently, have remained useless, from their ignorance of the original objects for which the separate parts were destined; and, secondly, I thought it would be easy to prove by the known precedence of my labours, and especially by the continued train of the same ideas, that the different pieces could only have proceeded from, or be rendered serviceable by me; for this simple reason, that those instruments, the object of whose construction they have not seized, and whose combination they have not understood, and, consequently, not imitated, could not answer any useful purpose. These are the motives that have prevented my preferring these claims sooner, and even now it is almost unnecessary; for it could only be of any importance, if the borrowed combinations were rendered serviceable.—And of this I am very much inclined to doubt the possibility.

As I proceed in the description of my in-

struments, I will point out the parts which have been so unjustly appropriated.*

Several writers, among whom there are some, however, who are not yet authorised to express an opinion on lithotrity, worthy of a moment's consideration, inasmuch as they are merely writers and not practitioners, have alluded to me in their works. I scarce know why they should, for having myself published nothing relating to my labours, I could not be fairly within their scope. Some of them, taking the text of their discourse from the old and imperfect accounts which had been given of my first sketches, have commented on the words of my unfaithful interpreters, and adding to errors, more numerous errors still, they have completely burlesqued both

* In this English translation of my work, I shall not enter into any of these details, which can possess but little interest to English readers. I reserve them for the French edition; for these borrowed instruments being unknown to English surgeons, and only attempted by French authors, whose writings have not been translated, it would be useless to load the present edition with the observations that would arise on this subject.

my thoughts, and the ideas which gave birth to each of my combinations.

I protest against their decisions, which ought to have no weight, since they were wanting in foundation; and I equally protest against those which may be passed upon the instruments which I now publish in this first part of my work, until I have made known, in the second part, the mode of employing them: for without this additional knowledge it is impossible to form a just idea of them. I now only submit to the judgment of the public the present volume, comprising a description of the action of these instruments on calculi, but independent of all contact with the organs. In the study of a new art we must proceed in due order, and when it is thoroughly understood how and why the action of these instruments is energetic on calculi out of the organ, it will then be better conceived how this action may be energetic on stones within the bladder, and the method of employing them in operating will then be

studied with greater interest and advantage. If this had always been the method pursued, a much clearer idea would have been gained by this time, of that which science requires in lithotrity; for we should have arrived at once at the knowledge of this important truth: *that an instrument cannot perform within the bladder that which it is essentially incapable of executing outside this organ.* Had this axiom, simple as it is, been applied at the commencement of lithotrity, it would have put an end to many uncertainties, to much unfounded pretension, and have shewn at once, what we had to expect from each of the means which have been successively proposed as eligible for the operation of lithotrity. This may be especially applied to the "perce-pierre."

I am yet ignorant—though, already, a sufficient number of pages have been written on the subject which occupies us—of the idea attached to lithotrity, but I should be tempted to believe that this idea is not what it should be.

To read some of the books which have been written on this new art, and see their poverty on the head of scientific action, and still more as regards the precepts which ought to be followed, one would be tempted to believe that this art consists only in the introduction of instruments into inert and insensible bladders, and then to charge the stone indifferently, by gentle or forcible manœuvres, and destroy it with more or less expenditure of time, as may happen. From this mistaken idea it results, that the lithotritic surgeon, in the opinion of some, has no more difficulties to conquer, than those which such a statement of things points out —that is to say, few or none.

This explains, in those who have wished to perform this operation, too much confidence, added to great negligence as to whether they possessed good or bad instruments—well or ill constructed—efficacious, or the reverse. They imagined, no doubt, that the organ in which they operated would accommodate itself to all the slowness of their operation, and

all the defects of their instruments; they have, in fine, a most unfortunate idea of lithotrity, when, without preliminary examination of the organ, or previous knowledge of the form and volume of the stone, still less of the difficulties to which this form and size may give rise—without even giving to this body an appropriate position—they introduce, without law or reason, and often with violence, an instrument, make the soft organ in which they operate yield to their hand armed with a steel inflexible rod, and thus manage to seize the stone—which but too often is so little in harmony, either by its form or physical properties, with the power and construction of the instrument employed. Thus the operator concludes with his trouble for his reward, the patient with the pains he has suffered, and science is marked by a failure.

In my opinion such a process may be defined, as one by which a stone is broken, but it forms no part of lithotrity; for this art requires skill, and not manual force—combinations, and not the empirical application

of one instrument—it requires, in fine, that the *means should bear some proportion to the difficulty.*

An operator, who would thus conceive or perform the operation of lithotrity, would be no more a lithotritic surgeon, than would he who should deliver a woman by seizing ignorantly and by force whatever part of the child presented itself, be a surgeon-accoucheur; or no more than an extractor of teeth would be a surgeon-dentist, who merely observes that there is a tooth to extract, proceeds directly to his object, and, neglecting all accessory precaution and care, concentrates against the unfortunate tooth all the strength of his muscles, and the power of his defective instrument, and shews to the gaping crowd, sometimes the tooth, but often with the gum round it, and a morsel of the jaw attached; common sense will tell us that these empirics can only succeed, when the tooth is not so firmly fixed as to bring with it the accidental accompaniments.

Lithotrity has already suffered much by

this manner of viewing it, and of putting it into practice; and if some failures have been noted, which may diminish its importance in the eyes of medical practitioners, these failures are rather due to the sort of quackery or empiricism which has flourished in it, than to any inherent defect in the art. In truth, this empiricism, which takes its rise from the ignorance in which surgeons originally were, as to the difficulties which influence the success of lithotrity, both with respect to the organs in which they operate, and the stones on which they act, could only be expected to cease entirely, when attention was closely drawn to these causes of difficulty; for the attention thus roused ought naturally to lead to reflection, and reflection destroys empiricism.

This quackery, however, has already had too unhappy an effect on lithotrity, to allow us to lose any opportunity of completely withdrawing this nearly-discovered branch of surgery from its yoke, or to fail in exerting every power we possess to present it to scientific

men, surrounded by numerous considerations which appertain to it, and which prove that, far from its consisting in the application of a sterile and poor resource, it requires, on the contrary, to be placed on such a basis, that, in a scientific relation, it may be on a level with the branches of art which demand the most reflection and cultivation.*

In fact empiricism, which never combines, never reasons, and to which the interests of science are always secondary, has hitherto allowed it to be supposed that lithotrity ought to be employed against the stone, without any previous consideration or reflection, much in the same manner as we employ a specific—*you have the stone, use lithotrity.*

Hence have resulted a host of abortive applications of this means of cure, and abortive for two reasons; the first is, that we were ignorant of the nature of the difficulties which might result from healthy or diseased blad-

* The art of midwifery for instance. There is ample material for a course of lectures on lithotrity, quite as interesting and replete with information as a course on midwifery.

ders, and from the form and size of the calculi, which ignorance led us into frequent error; and the second, that the means employed had a power so limited, and, consequently, so often utterly disproportioned to the difficulties to be overcome, that too frequently the case was not successful, though often (setting aside the volume of the stone) the probability existed of a speedy and safe recovery.

A study of the organs and the calculi was therefore necessary to form a basis for the science, as well as that reflection, which, by leading to the discovery of new combinations, might give to the lithotritic agents a degree of power proportioned to the difficulties presented by stones under the double aspect of their form and size. This I have attempted to perform.

Since I have devoted myself to the study of lithotrity, I have had many difficulties to conquer, both in the invention of the means, which I announce in this work, in the study of the laws which govern the organs in which we operate, and, lastly, in the bodies which

we are called upon to destroy. But the greatest difficulties I have met with, and they are those which I shall have to combat with for some time, before my instruments and opinions will be generally admitted, are the facts brought forward with a view of proving that lithotrity, such as it was with the "perce-pierre," did not require improvement, and, in one word, that it needed no assistance.

Though such a decision sufficiently indicates that he who pronounces it views his subject with no very philosophic eye, since it presupposes that he is uninfluenced by the progressive movement, which is so strongly given at present to all that may be termed art or science, yet it is right that we should shew how entirely without foundation such an assertion is.

Whenever a new operation is brought to light, its existence is divided into two distinct periods. During the first of these periods general attention is only fixed on the efficacy of the means considered in an absolute manner, that is to say, independent of

all distinctions of method in performing it. Is the operation successful or not? This is naturally the first question; and it is only secondarily that we inform ourselves in what proportion it succeeds. The second period, which is much longer, is that which elapses from the moment when facts have become sufficiently numerous to prove the efficacy, more or less certain, of a means of remedy, up to the period when other means, more perfect and of different origin, supply its place.

It is during this period that the art which has sprung to life from human invention, finds in that inventive faculty the means of improvement, by a continuation of the same process as that to which it owes its birth. It is when all the friends of science recover from the feeling of surprise with which they received the first idea, when they examine it more leisurely, regard it in its true aspect, and free it from all the clogs and impediments which private interests tend to throw in the way of its advancement.

Lithotrity has already passed through the first of these periods, it now begins to accomplish the second; but that it may be enriched, and become as rapidly perfect as it will allow, it is necessary that it should be freed from all the shackles of empiricism, and that the means of justly appreciating the value of each of the parts which may arise to forward the perfection of the process, should be infallible.

Lithotrity, truly considered in its essential character, and analysed, is but a purely mechanical affair, consisting only in the pulverization of a stone with more or less rapidity and gentleness towards the organ, which leads to the simple conclusion, that in order justly to appreciate the degree of perfection to which it is carried, the action of its agents should be examined independent of all collateral circumstances. This is what has not yet been done.

Hitherto it has been thought right to rest an opinion upon facts alone, without taking into consideration circumstances that might

influence them. This, no doubt, was found sufficient, when proving the possibility of a cure by lithotrity was the only object; but now that it is necessary we should know the relative goodness of each of the instruments, more is required. To draw conclusions from the facts alone, is a vicious system, and must inevitably lead to error; for, besides that an author, whoever he may be, is always inclined by the weakness of human nature, to regard a fact which springs from himself, under a favourable aspect, very different in degree to that which he bestows on the property of another; a lithotritic fact especially has this peculiar inconvenience, that since it *takes place in the dark*, the operator himself may be deceived as to the nature of the observation he offers. The fact then, though simple, may thus undergo transformation, enlargement, fashioning, arranging, &c., till it appears to the eyes of surgeons a supernatural thing, and consequently nearly inimitable.

If, on the other hand, instead of consult-

ing facts, such as they really are, we consider their number without taking note of the particular circumstances in which the practitioners were placed—such as the proportion of patients—the nature of the disease:—the amount of the number will prove a very illogical mode of reasoning with a view to the attainment of the truth.

It must be evident that too many circumstances may interfere to render a correct judgment possible by such means; that formed upon such grounds it must necessarily be false, even when the facts have been given with candour, truth, and especially with such accessory particulars as can alone give them value or render them current in science.

Moreover, in the instance of a patient treated unsuccessfully by lithotrity, and presented to medical men as a subject for their consideration, two matters must be considered. First, the application of instruments on the stone, and in the interior of the bladder in which the operation is performed; and, secondly, the circumstances which depend

on the patient, and which may sometimes delay or prevent the recovery. How shall we know if the operation has failed because the instruments have been feeble in their action, or defective in some other way, or if it is to be attributed to some peculiarity of conformation in the patient which presented obstacles of a nature that did not admit of being overcome? Do not nearly the same circumstances present themselves in a successful case; and can the facts offered indicate with sufficient exactness, all the peculiarities which were attendant on the disease, to enable the action of the instruments to be justly appreciated? Are there not stones of every size, of every form, and of every degree of hardness and density? bladders which present various dispositions, every degree of sensibility? I have no hesitation in saying that in one hundred patients, no two will present exactly the same circumstances—where then are the points of comparison possible? And if we cannot find two patients under the same condition, all possibility of experiments

by comparison, must necessarily be excluded; for what good will result from considering facts which do not spring from the same causes?

I believe it unnecessary to dwell longer on this subject, in order that my readers may draw the conclusion, *that the facts of one or several cases in which a cure has been gained by lithotritic agents, cannot lead to the exact appreciation of the means or instruments employed.* There is only one mode of arriving at this result, without which lithotrity will always be subject to empiricism, and this mode is by having recourse to *demonstration*;* with it

---

* By *demonstration*, I mean the application of lithotritic instruments on vesical calculi, and in the bladder of a cadaver, performed so that those who are appointed by the learned bodies to examine their efficacy, may see what passes in the interior of the organ, and thus appreciate in what degree of perfection the two principal conditions of lithotrity are fulfilled; that is to say, 1st, The absence of all lesion of the walls of the organ; 2dly, The rapid pulverization of the calculus.

I think that a commission chosen to examine and investigate all that relates to lithotrity, after having first compared and examined the means proposed by the different authors for placing the patient, and fixing the instrument while the pulverization is effected, may require them to shew, in the fullest detail, the manner in which they effect the crushing of the stone. They might first desire to

every thing in lithotrity becomes clear—the relative goodness of an instrument is at once

---

see the pulverization effected on stones of different form and size, out of the bladder; and by afterwards placing calculi, varying in the same manner in their form and size in the bladder of a cadaver, they may examine the relative degree in which each of the authors, by means of their instruments, can acquire a preliminary knowledge of the stone or stones, as regards their shape and volume.*

They might then examine what influence the position of the patient has on the situation of the stone, and see which means of placing the patient is the best adapted to make these positions favourable to the success of the operation.

They can finally examine the instruments proposed by the authors, and require that they should make them act on small spherical stones—large and intermediate spherical calculi—small, middle-sized, and large oval stones—the same different sized flat ones—on a number of small round ones—and finally, on fragments.

To go through this examination, and to put the authors examined in the same situation as when they actually operate, they ought to be required to proceed to the destruction of the stones, without seeing any thing that is going on in the bladder, and without having received any previous information. The examiners placed so as to see and be able to touch the organ, which is fairly displayed, and distended with water, may judge by the bulges which the instrument makes in the posterior walls of the organ, whenever the instrument comes in contact. At each question of the exa-

* It will be understood how necessary this preliminary knowledge is to the lithotritic operator; since the shape and volume of the calculus exercises a powerful influence in his choice of an instrument that shall rapidly destroy the stone.

ascertained and noted; the wants of science are well expressed, well understood, unfounded pretensions fall, the physician or surgeon finds in it a study which ought to lead to success, he knows what he ought to take or reject, and, in fine, his imagination is not lost in a chaos of instruments, of systems, of discussions and critiques, with which some ignorant authors have inundated the science to obscure it, and

---

miner, the surgeon who operates ought to explain what he is doing in the bladder at the moment in which he is questioned; and, if necessary, he ought to permit the bladder to be opened, to verify the accuracy of his description.

The examiners might even make the authors operate "dry;" that is to say, without any water in the bladder, which, thus emptied and opened at its posterior part, would allow them to examine, at leisure, the degree of harmlessness of the instruments for the neck of the bladder, the resources which they afford the surgeon, and finally, the ability which each displays in the double action of seizing the stone and pulverizing it.*

It would be after a report, circumstantial and well authenticated, had been made, in this spirit of analysis, that the authors of the various means to render lithotrity practicable would be classed, according to their respective claims, and that this branch of surgery not only might increase in its resources, and improve in its results, but be fairly appreciated in its present state.

---

* As I address myself more especially to the learned bodies of France, I will describe, in my French edition, all the points in lithotrity which they ought more particularly to examine and dwell upon.

pass by favour of the darkness they have created.

Without it, every thing in lithotrity remains obscure and uncertain; no precise determination can be taken by the man who studies this art, if the *demonstration* does not shew him to what degree of perfection the lithotritic instruments have been carried; he will believe science still poor, and not only will not employ a means, the advantage of which is unknown to him, but he will lose much valuable time in inventing: he will make attempts—and each attempt will require a sacrifice.

Without the *demonstration*, in fine, lithotrity will be of but little service to humanity, and as long as learned societies called to the direction of human knowledge, fail to employ rigorously this means of investigation, this proud conquest of modern surgery will remain tainted with a kind of cretenism by which its growth is now impeded.

In conclusion, a man of science should

require of an author who has constructed a lithotritic apparatus, a *demonstration first, and afterwards the facts,* and only believe in the existence of the fact where the demonstration *proves it possible.*

This is the only way of cutting short discussions, which will last as long as those who are not guided by any sense of honour, have not before them the fear of being unable to execute under the eyes of honourable men that which they pretend to have done unseen.

Here we will conclude these observations, which we leave to the consideration of those to whom the instruction of the public is confided, and will proceed to explain the intentions by which we have been guided in writing this book.

Whatever may be the nature of the labours I have undertaken, and the advantageous results I attribute to them, I do not think, nor do I hope, that lithotrity, such as I have made it, has no farther need of additions, or cannot become more perfect. Though at present I

do not see how each of the problems I have described can be more advantageously solved, I am far from pretending to set the same limits to the faculties of my medical brethren which mark my own. Hence it follows, that I give this work only as a faithful explanation of the best I have been able to effect, and not as a description of that which is perfect. All that I can say is, that I have laboured long and arduously at the instruments which are now described, and that I have neither spared time nor expense in the endeavour to make them satisfactory; that very far from having been satisfied with my first attempts, I have only stopped when very evidently and certainly each of these combinations appeared to me to have made as near an approach to perfection as I believed them susceptible of.

Perhaps this remark may induce authors, who have spoken lightly of them without sufficient knowledge, to retract their opinions, and perhaps also it may prevent some practitioners from admitting, with a facility that

does not always indicate modesty, the necessity of making alterations in them.*

* I cannot here omit making some observations on the haste with which some medical men propose alterations in the combinations which each author presents as fitted for any operation. In general these changes, which the public, but little informed on the subject, too often receives as an improvement, sets aside all that the original combination presented of real utility, and thus it commonly happens that a useful invention is converted into a dangerous one. It is in this manner I have seen transformed, not only the greater part of the instruments which I employ in the practice of lithotrity, but also the bed and fixed point, which I avail myself of. Truly, I am too great a friend to science not to desire that others should attempt to improve anything useful that I may have imagined; but I think that these improvements can only be effected after matured thought and numerous attempts, and not in the same manner as a woman would change a ribbon or a feather in her head-dress. Lithotrity is not a subject that can be thus lightly treated; and as I have only decided on publishing my instruments, after having laboured seven years to bring them to their present state of perfection—after having subjected them to trials of every description on numerous stones, artificial and natural, within and without the organ, in which they were destined to act, in patients and in subjects, I think I have some right to expect, that any changes that may be proposed should be founded on something substantially important, and should be the result of experience, and not of caprice, or of a too vivid imagination.

In conclusion, to put all on their guard against pretended improvements, I ought to say that, in general, those which have been proposed in the books already published on lithotrity, have for the most part been errors, which I had myself passed through, and this is quite natural, for the same problem given to solve leads necessarily to analogous ideas in the authors who devote themselves to it. It would be distressing to me to see received as novelties, and still

I have endeavoured to present the urinary organs, and the calculi which form in the bladder, in their proper relation to the new art. In this, as in my instruments, I have sought to do the best, but I am far from believing I have avoided all error; perhaps even these errors may be numerous; nevertheless, I have written with confidence, for I am persuaded all who read will take into

---

more as useful novelties, changes which will destroy the fruits of so much study, and which, when accurately analysed, are found to consist of the faults I have only worked through myself, after successive and continued labours and combinations.

After innovations, that which I most fear for my system of lithotrity is the bad construction of instruments. In general too little trouble is taken to ascertain if the instruments procured are accurately and properly adapted; so that the surgeon who purposes to practise lithotrity, finding a general resemblance to those instruments which are published, supposes, with fatal facility, that his instruments are as perfect as can be desired, and the unfortunate attempts he makes with them he flings back upon the author who constructed their originals, instead of attaching his failure to the workman who manufactured the copies.

A workman may make instruments highly polished, well finished, and even very ingenious, but alone he will never be able to make a scientific instrument; it is absolutely necessary that this workman should be directed, for there are a host of indications to fulfil, which have been revealed to the inventor, and to the inventor only, who has from deep study and long experience drawn forth the materials which constitute the perfection of his instruments.

account the difficult nature of the undertaking, and not exact that a new subject, hitherto without any analogy in science, should be treated with all desirable perfection. Compelled, besides, by the silence of those who have preceded me on this subject, to search for and charge myself with all the truths that may refer to lithotrity, my labours must necessarily suffer from this default of assistance and predecessors.

I have experienced great difficulty in giving a precise idea of my instruments, for, on the one side, it was necessary to avoid a description so minute as to fatigue the reader; and, on the other, one so laconic as not to be understood. Placed between these two rocks, I have endeavoured to steer exactly in the middle, and enough, I trust, has been said to convey to surgeons a sufficiently precise idea of these combinations. Study, and more especially experience, can alone give them a perfect knowledge.

In the description of these instruments, I have avoided giving to each of the parts the

terms used in mechanics, and this for two reasons:—The first is, that mechanics form a branch of science with which I am by no means familiar, and its vocabulary I am unacquainted with; the second is, that I should not be understood by the greater number of surgeons, for whom my book is especially destined. I have simply given to the different principal parts, which compose the apparatus, names which indicate as much as possible their use, in order that, in the second part of this work, when I describe the manœuvres of the instruments, I may be clear and concise. Without this precaution I should have been obliged to employ far too many periphrases to make myself sufficiently understood.

Although, as I have said in the commencement of this Preface, I do not consider the examples of cure as a necessary proof of the excellence of a means, I have however thought it desirable to add to this treatise a certain number of cases: they are offered to the public, not to prove the superiority of my

instruments—*since the demonstration can alone furnish that proof*—but with the intention of giving to these combinations the rank that befits them, by proving that they have been employed, and have served to cure patients. Without these cases, my instruments could not be considered as occupying a place in the science, and would risk being classed with those numerous attempts which rest without ever having been employed, and which have been forgotten after attracting an ephemeral attention. My intention is, besides, not to command the opinion of the medical profession, by presenting facts which they may suppose have been ill observed, or presented under a favourable aspect, to give value to a system, or serve a private interest; I prefer convincing them by addressing myself to their understanding, and in demonstrating the possibility of doing whatever I advance. This mode of proceeding is more in harmony with the respect I entertain for the profession, and with the opinion of one of our best philosophers, who has said, that

one single demonstration carried more conviction than fifty facts.*

Farther, if we reflect fully upon this subject, the moment is not yet come for drawing from facts which are at present springing into existence, the expression of what lithotrity may become. This science is yet too young to allow us to imagine that it has not still to grow and produce fruits even more consoling to humanity than those hitherto obtained.†

I shall postpone then to a time, which at present I cannot indicate, the publication of facts, which I may be allowed to consider as the expression or measure—the most advantageous possible of the power of lithotrity;

---

* "Une démonstration me frappe plus que cinquante faits; grâce à l'extrême confiance que j'ai en ma raison, ma foi n'est point à la merci du premier saltimbanque."—*Diderot, Pensées Philosophiques.*

† For example, the facts which we now present can only give a very imperfect idea of our means; for these cures having been obtained at different periods of my labours, each can only form the measure of what I could effect at the moment in which the patient was treated. I relieve patients now which I could not have cured three years back, and perhaps three years hence I may cure patients who are now beyond the scope of my means—and this is probable, for I continue my studies.

for this power can only be developed when study and experience shall have stamped *the respective value of each of the mechanical combinations invented for its practice, and the relative goodness of each of the manœuvres destined to draw from each of these combinations the greatest possible effect.* To arrive at this result, I shall always bear in mind the formula which results from certain considerations placed in this Preface: *The object is not now to practise lithotrity—but to practise it well.*

TREATISE ON LITHOTRITY.

INTRODUCTORY OBSERVATIONS.

SINCE medicine has become a science, many diseases, which had previously been considered as among the most dangerous, have assumed a less important station in the list of human infirmities.

Many of these have become of a less serious nature by being changed in their character, but there are others which are no longer so severe, since we have discovered the means of arresting their progress, and counteracting their effects.

Of late years, the stone, that most serious complaint, has experienced one of those happy revolutions in its mode of treatment; and most assuredly this is not the least important of those benefits, for which human nature is indebted to medicine.

There were, in fact, few diseases which excited more terrors in the mind of the patient; he had formerly only the choice between a life of pain and suffering, and the risk of an operation, too frequently terminating fatally.

With such an alternative, the patient was unable to decide till the severity of his sufferings overcame his irresolution, and then as a last resource he placed himself under the care of the lithotomist. What was the consequence of this delay?

The bladder became diseased, and sometimes disorganized, the stone increased in size, and the constitution became seriously affected, thus rendering the success of the operation still more uncertain than it would have been, had the patient submitted to it soon after the first formation of the stone.

The invention of a milder method, and one which did not require the gloomy apparatus of lithotomy, and above all, which was exempt from its fearful risks, ought then to remedy so grievous a condition.

Lithotrity, or the pulverization of calculi in the bladder, was the means by which this desirable change in the treatment of calculous patients was to be accomplished: it consisted, in fact, of instruments so constructed as to be introduced into the bladder, through the urethra, and to reduce the stones formed in this organ into powder, or fragments sufficiently small to be expelled through the natural passage. These means, by which numerous cures have been already obtained, will, when generally known, studied and adopted, have the most desirable and happy results for human nature, in saving it, with very few exceptions,

from the melancholy consequences of the double affliction of stone and lithotomy.

The first and most happy result of lithotrity will be then, to banish from the minds of patients that dread which lithotomy has produced, and to induce persons thus suffering to have the calculi removed at the commencement of their formation, and not to wait till the bladder becomes diseased, and diminishes the chances of success.

The second consequence of this operation, which results from the first, will be to prevent these patients passing many years of their lives in suffering and misery; for, not recoiling from an operation, the performance of which they know to be almost entirely free from danger, and generally little, or not at all painful, they will readily offer to submit themselves to it, without being compelled.

If, however, lithotrity includes, in its general results, so many advantages over lithotomy, it also presents secondary ones, which are most important. A few observations on these two operations, compared with each other, will demonstrate this most unanswerably.

Lithotomy requires to be performed in a favourable season; lithotrity may be performed at all times, with equal chance of success: the former requires that the patient should remain in bed for a month or six weeks after the operation, the latter needs no confinement, and often allows the

for we make it disappear by forming a supposition which is unfounded, and would not be admitted if we referred to known facts—will the other be more so? Let us offer, in opposition to it, facts and reasonings. Complete cures have been obtained, for in the first place a great number of calculous patients, who were treated a long time since, have had no return, which proves that in their cases no fragments could have been left to form the nuclei of other calculi; secondly, patients treated and cured by lithotrity, have died a long time afterwards from some other cause, and on examination no vestige of any calculus could be discovered.

But in admitting, that which is certainly possible, that one or two fragments do remain in the bladder of a patient who has undergone this operation, these fragments will give rise to fresh symptoms of stone, which will only require another and last application of the instrument, and which cannot produce any great inconvenience.

If, besides, we bear in mind that lithotrity must not be considered in an absolute manner, but relatively to lithotomy, we shall say that fragments of stone, and even whole calculi have been

---

metal after a certain time: for example—do not axle-trees sometimes give way notwithstanding their great strength and size? And can this be proposed as an objection to lithotrity? A surgeon who operates with instruments which have been well tried, and who renews them as often as is necessary, will never meet with such accidents.

left in the bladder after this latter operation, which necessarily leads, not to the harmless re-introduction of the instruments of lithotrity, but to a second operation of lithotomy, an operation of much greater severity.

Thus lithotrity still maintains its advantages in every respect.

Of all the means which art has devised for the relief of mankind, there is perhaps not a single one that has been received with more astonishment, or more slowly understood, than lithotrity. Having for its basis, a law in direct opposition to the prejudice generally received among surgeons, it did and still does meet with much incredulity from those who have not seen it employed.

Having been accustomed to sound the bladder with curved instruments, they believed that this curvature was absolutely necessary for the instrument to pass into the bladder, and thought that this form was too great an obstacle to the development of sufficient power to destroy calculi, sometimes extremely hard and of considerable size.

Before the destruction of stones in the bladder, by an instrument passed through the urethra, could be undertaken with success, it became necessary to prove that a perfectly straight sound of three or four lines in diameter could be passed into that organ.

Lithotrity, founded upon this principle, must have been comprehended with difficulty by the

generality of surgeons, and the more so as the seizing of the stone, and reducing it to powder, was to them a problem difficult to solve, if not quite impossible. Not being able to derive assistance from any analogy in science, they had some difficulty in understanding how a stone which could scarcely be felt in the bladder with the sound, was to be seized and reduced to powder in that organ.

If lithotrity could not be comprehended at its commencement, if at the present time, after such great success, so imperfect and confused an idea is formed of its powers, how can the advantageous changes it has undergone be duly appreciated? An entirely new science, it has advanced too rapidly to be closely followed in its progress.

In fact, lithotrity, though scarcely known six years since, and which, at first, consisted only in the employment of an instrument possessing the simple power of grasping a stone and perforating it, has arrived at such a degree of perfection, that it may be considered as forming a set of doctrines, as capable of being examined and developed as any of the other branches of surgery, which, from their extent and importance, have required particular study.

It is with the desire to explain this system, that I have undertaken this work; but before entering into it, I shall seek to give, by a rapid sketch, some idea of the state in which lithotrity was, in

the hands of those who preceded me, and what it now is, after the attempts I have made to bring it to its present state.

Man suffering from stone, must have been a long time without knowing the cause of his sufferings. The presence of one of these foreign bodies in the interior of a hollow and large cavity, could only have been ascertained by examination after death, or what is more probable, when, by some effort of nature, these foreign bodies suddenly escaped by the ordinary passage. When these patients, in the earlier ages, endeavoured to get rid of this afflicting complaint, they doubtless sought to be cured in the same manner, and assisted as much as they were able, in increasing the chances of a recovery which might be purchased without much suffering, and, above all, without the risk attendant upon the cutting process.

The ancient Egyptians were those who studied these means with most success; the principal aim they had in view was to dilate the urethra, in order that the calculi formed within the bladder should be carried out through this canal. By these means they succeeded in curing patients of the stone; this method was afterwards abandoned, for it was found to be only applicable when the stone was small. Art was, however, soon enriched by means more suitable for the extraction of large calculi. Compelled by the sufferings of the patients to cut into the bladder, which could not then be

otherwise relieved from the stone, the surgeon soon found that this operation was more shewy, more expeditious, and above all more easy: and he abandoned the old, but safe practice of the ancient Egyptians, whose patient and practised followers would have restored to health many persons afflicted with small stones, who since that early period have fallen victims to the knife of the lithotomist.

It was a great misfortune for human nature, that this primitive idea of extracting calculi from the bladder, through the urethra, was so long abandoned; doubtless, if this idea had been cherished, we should long since have been in possession of means similar to those with which we are now occupied.

The natural expulsion of stones of large size, might have shewn how great a diameter the urethra sometimes had; the accidental breaking of these stones during their extraction through the urethra, might have given rise to the idea of breaking them in the canal, and even afterwards in the bladder; in short, these combined ideas, joined to the practical knowledge of the straight sound which some of the ancients possessed, would long ago have shewn that it was possible to attack stones in the bladder, and even to extract them from this organ through the urethra.

It grieves us to reflect that these means, by which so important an object has been obtained,

existed so many years without being brought into action; accustomed to subject the unfortunate patients to an operation, expeditious, but at the same time painful and hazardous, the surgeon occupied himself in devising means by which he might render it less dangerous, entirely forgetting that in former times it was possible altogether to avoid its dreadful consequences.

To render justice to the surgeons of those times we must, however, refer to some passages in their works, which prove that several among them had formed some ideas relative to the subject now under consideration.

In 1519, Alsaharavius expresses the idea only, of breaking small friable stones in the bladder with an instrument, (instrumentum subtile) of which, however, he gives us no description. In 1626, Sanctorius gives the plan of an instrument composed of a tube, one extremity of which divides into three flexible branches.* He says that if a fragment of a stone, or an entire calculus, descended from the kidneys, and was not expelled with the urine soon after its descent into the

---

* All these primitive instruments are drawn in the plates of M. Leroy's interesting work, entitled, "Exposé des divers procédés employés jusqu'à ce jour pour guérir de la pierre sans avoir recours à l'opération de la taille (Paris, 1825)." This work may be procured at Baillère's, 219, Regent Street.

The instrument of Sanctorius is drawn (Pl. I., figures 16, 17, and 18).

bladder, it might be extracted by first filling this organ with water, and then introducing the instrument he speaks of through the urethra, the branches of which, when arrived in the bladder, should be expanded, and applied close to the neck; he thinks that by then letting the water escape, the stone would be carried forward towards the three branches, seized by them, and extracted by withdrawing the instrument from the bladder. This author proposed also, and it is Haller that relates it, that if the stone should be too large to be extracted, it should be perforated with a stylet.*

Sanctorius does not mention of what material his instrument is to be composed, but the drawing he gives of it, and more especially the mechanism by which it acts, clearly prove that it must have been soft and flexible. This circumstance distinctly shews that he had no thoughts of rectilinear catheterism.

Some time afterwards Severinus stated that Joannes Germanus had proposed to him an instrument to seize the stone in the bladder, and

---

* Haller relates this of Sanctorius, but we do not find in his work any idea of the kind; Haller thought he had seen it in Sanctorius, because he mistook the figure, and took the stylet which Sanctorius destines to reunite his triple branches, for a perforator. It results, therefore, that Haller, without being aware of it, invented lithotrity, whilst at the same time he believed it impracticable, for he adds—Speculationem puto meram.

to extract it; this instrument had three branches serrated internally and slightly curved inwards; Severinus only gives a very imperfect description of the mechanism of this instrument, and does not mention how it is to be constructed, or whether it should be curved or straight.*

Thus Prosper Alpinus, who described the Egyptian mode of operating, Alsaharavius, Sanctorius, and Joannes Germanus, are the only ancient authors, whom a reasonable analogy would lead us to acknowledge as having conduced to the art of seizing the stone in the bladder, and reducing it to fragments.

Without attaching any great importance to the ideas of these authors, which doubtless were entertained by many others who did not publish them, we quote their names, as they will make an honourable figure in the history of the method we are now discussing.

Science only possessed, in mechanical means for enabling calculous patients to avoid lithotomy, the very slight resource we have just mentioned, when a new series of ideas arose, and gave a fresh impulse to this branch of surgery.

Constant and long attention to those whose urinary systems were diseased, brought to light

* There is every reason to suppose that it was not to be straight, for such an innovation would have been still more surprising to Severinus than the instrument itself, and he would without doubt have mentioned it.

many important facts concerning the bladder and the urethra, the knowledge of which only required an ingenious application, to render them of infinite service.

There were found, by Dr. Edmund Clarke, in the ruins of Herculaneum, straight stylets, which it is believed were employed in catheterism. Lieutaud, Morand, Santerelli of Rome, Lassus and some others, had affirmed that it was possible to pass a perfectly straight sound into the bladder; and further daily practice shewed, that the male bladder might be examined with the sounds employed for females, which are nearly straight; the treatment of strictures in the urethra had proved, that a sound of four lines and even more might be introduced into this canal; small calculi had been sought for at the neck of the bladder, and even in the organ itself, from which they had been extracted; and lastly, two individuals,* strangers to the profession of surgery, but whose sufferings had rendered them ingenious, had, with instruments, certainly very imperfect, attacked the stones in their own bladders, and had succeeded, probably without perfecting a cure, in extracting some portions.

All these unconnected facts led to no con-

* Colonel Martin and a monk of Citeaux. If we refer to the 1st pl. 19 fig. of M. Leroy's work, we shall find a drawing of the instrument made use of by Colonel Martin: it is simply a curved steel sound, slightly serrated at its convexity.

clusions of any service to science, until the year 1813, when a Bavarian physician, Doctor Gruithuisen, constructed from them the basis of a mode of operating, the result of which has been the scientific cure of calculous patients by mechanical means, and without making any incision. Opposing facts to prejudice, he publicly, *before experienced persons*, performed catheterism with a *large straight sound*, upon the living subject.

Beginning with this fact, which he stated to be the foundation and the basis of his new doctrine, he conceived it possible to attack stones in the bladder, by mechanical power, and pointed out the mode that he should employ to accomplish this purpose.

Through his straight and hollow tube first introduced into the bladder, he recommends another to be passed, conveying a metallic wire nicely adapted to encircle the stone, and fix it against the open mouth of the second tube; he then recommends the small crown of a trephine to be introduced through this second tube; and, lastly, he recommends to perforate the stone, which is kept fixed by the loop of metallic wire, with the trephine, to the handle of which a pulley is to be attached, to be worked by means of a drill bow.*

* The instrument proposed by Dr. Gruithuisen may be seen after the translation of his "Mémoire," in the plates of my letter addressed to the Academy of Sciences, page 86. M. Leroy also

But the service Dr. Gruithuisen has rendered to science, is limited to the description only of his ingenious ideas, after having proved by *experiment the fundamental and important fact*, that catheterism might be performed *with a large and straight sound.**

gives a drawing of them in his work (Pl. I. fig. 1, 2, 4, 5, 8). But it is better to consult my plate, which is traced exactly from the German work.

* The Institute of France awarded in 1828, to Dr. Gruithuisen, a gold medal of the value of 1,000 francs, in the intention of rendering to all who had contributed to establish the operation of lithotrity, the justice which was due to their exertions.*

I esteem myself happy in having, by my writings, and more especially by my letter to the Academy, given rise to a more attentive investigation of Dr. Gruithuisen's claims to the invention of lithotrity, and the judgment recorded by the Academy in favour of this foreign physician, proves, so much the more fully, his

* The Commission of the Institute express themselves in the following manner relative to M. Gruithuisen : " La commission dans l'intention, en ce qui regarde la lithotritie, de rendre à tous ceux qui ont concouru à créer cette utile opération la justice qui leur est dûe, et ayant acquis la certitude que M. le Docteur Gruithuisen, dès l'année 1813, a proposé un système d'instrumens qui montrait la possibilité de parvenir un jour à broyer la pierre dans la vessie, qu'il a employé sur le vivant à plusieurs reprises *des sondes droites d'un gros calibre*, et que par là il a une part non douteuse dans les inventions relatives à la lithotritie, a décidé qu'une médaille d'or de la valeur de 1,000 francs serait adressée à M. le Docteur Gruithuisen."

Now relative to this, we would remark that the most ancient documents which M. Civiale brings forward among his proofs, goes no further back than 1817, and the memoir of Dr. Gruithuisen dates from 1813. Even setting this aside, M. Civiale's proofs are not of the most convincing nature.

From this moment the skill of professional men, which, during so long a period, had effected little towards treating calculous patients without incision,

---

claims, and the justice of the Institute, that the first commission which that learned body appointed to report on the new operation, failed in fully appreciating all the service Dr. Gruithuisen had rendered science, when they described his labours as *entirely theoretical and speculative.* It is evident that this commission in thus expressing their opinion had not sufficiently investigated the subject, since it is clear that Dr. Gruithuisen having passed a *straight* sound of large calibre in a patient, was not a mere *theorist and speculator*, but an *operator.*

Besides, this idea that the project of Dr. Gruithuisen existed only in *theory and speculation* did not appear to us, at the time in which it was republished with so much ostentation by M. Civiale, to effect the purpose which the latter had in view—that of depriving Dr. Gruithuisen of his claims as author of the method of breaking up the stone in the bladder. For it appears to us, that theory and speculation precede the fact with all ingenious men—for whatever is not the result of speculation must be the effect of chance. Dr. Gruithuisen could only be justly considered as the author of theories of slight importance or value if they had not been realized—the contrary is the fact.

M. Civiale, in the preface to his work, quarrels with my endeavours to render justice to Dr. Gruithuisen, by giving to this physician the honour of the invention of lithotrity; and thinks it deplorable that I should seek to deprive French surgery of the honour appertaining to the discovery of this new method. While on our part, we are extremely edified by the disinterested anxiety M. Civiale evinces for his country, we think we honour it quite as well, by shewing ourselves just and true; by attributing to foreigners that which is their due, more especially when the press has furnished incontestible proofs in their favour. To act otherwise would justify the belief that we are capable of envying foreigners

received an impulse, and the annals of science soon announced the fruits of new conceptions.

In 1819, an English surgeon, of the name of

---

their claims to honour and glory—and certainly we possess enough to allow others their share.

If a Bavarian has invented the *method* of breaking up calculi in the bladder, Frenchmen have discovered the *means* by which it is rendered practicable. In this there is a division of glory from which M. Civiale is not excluded. At all events M. Civiale will doubtless admit that our opinion was not so utterly deficient in justice, since it has evidently been shared by the Institute.

In the same preface, M. Civiale asserts that *it has been published in Paris that Dr. Gruithuisen was the only and sole author of lithotrity.* Here M. Civiale *misquotes*, probably in the hope of exciting compassion, by shewing himself the victim of injustice. And since this physician alludes to my letter addressed to the "Archives de Médecine," in March, 1826, I feel it my duty to rectify his quotation. I said:—"If M. Civiale refuses to accord to Dr. Gruithuisen that which he merits, and especially if he seeks to rob that author of the favourable opinion he has won, by seeking among the ancients the starting point of what he calls lithotrity, he does it with the desire of not finding in a contemporary, not a rival, but the only author of the method, and first steps for extracting calculi through the urethra."

Thus I have not written that Gruithuisen was the *sole author of lithotrity*, which includes the complex idea of the invention of the *method*, and the invention of the *different means* for putting it into practice. Gruithuisen has invented the *method*, and pointed out the *first steps* towards carrying the method into effect; and we Frenchmen have pointed out other steps and means which have over the former ones, the advantage of being practicable and of effecting the cure of patients. The whole is to be understood, but we shall never come to an understanding respecting the inven-

Egerton, proposed an instrument for breaking down stones in the bladder, but in the construction of it he deviated from the plan laid down by Dr. Gruithuisen; his instrument is curved, and although ingeniously conceived, it cannot fulfil the object for which it was invented, and therefore remains useless.*

In 1822, during the month of May, two sur-

tion of lithotrity, if we persist in confounding the *method* with the *operative steps*.

He who has first made the public recognize the fact that a *straight sound of large calibre* may be introduced with facility into the bladder of a patient, and who has improved on this fact by conceiving a plan for the destruction of vesical calculi, by means of this straight tube, has invented the *method*—and this Dr. Gruithuisen has done. Why are we compelled to explain things so clear and simple?

The memoir of Dr. Gruithuisen is inserted in the Medico-Chirurgical Gazette of Saltzburg (March, 1813), and bears a very significant title: "*Ought we to renounce the hope entertained in former times of destroying stones in the bladder by means—either mechanical or chemical?*" I have published a French translation in my letter to the *Académie des Sciences*.

* I am now only writing historically and simply state facts, and do not in any way condemn M. Egerton's idea of constructing curved instruments, since it is possible, in my opinion, to succeed in destroying vesical calculi, by means of instruments presenting a curvature; but I think I may now give as a rule, that they must be perfectly *straight* in that portion which is to remain in the urethra during the operation. I have laid down this rule in full among the generalities which precede the description of the instruments. For M. Egerton's instrument, see M. Leroy's work (Pl. I. fig. 9, 10, 11).

geons, Messrs. Amussat and Leroy (D'Etiolle) presented at the same time, the result of their labours to the Academy of Medicine. M. Amussat, after having proved by his anatomical researches the facility with which a straight sound may be introduced, which Dr. Gruithuisen had already victoriously demonstrated in the fact, proposed also an instrument for breaking down stones in the bladder; this instrument is straight, but by its mechanism he does not appear to have availed himself of Dr. Gruithuisen's idea, which was to destroy the stone by means of a trephine, made to act in the bladder by means of a drill bow. In the instrument of M. Amussat, the destruction of the stone is entirely effected by the pressure of the branches of which it is composed, which are made to act alternately by means of a lever, and thus ought to crush any foreign substance placed between them. This instrument also remains useless,* but, as well as M. Egerton's, it will perpetuate to posterity the laudable endeavours of two scientific men to invent a method of relief for the sufferings of mankind.

M. James Leroy (D'Etiolle), after having caused several instruments to be constructed in order to attain the object to which he had long aspired, thought he had at last accomplished all

* M. Amussat's instrument is drawn in the plates of M. Leroy's work (Pl. II. fig. 9).

the indications he considered requisite; he judged one of his instruments well adapted to destroy urinary calculi, and gave it the name of *Lithoprione*. This instrument is composed of a hollow straight sound, through which M. Leroy wished to perforate the stone by means of a metallic rod,* turned by a winch handle. In the construction of this instrument, M. Leroy, although beginning to put into execution ideas analogous to those of Dr. Gruithuisen, improves upon the conceptions of this physician. He substituted for the metallic wire which the latter destined to secure the stone, four watch-springs, united together at one end by a kind of button, which when the instrument is shut, forms the extremity of the sound, these four springs, introduced through four grooves made in the interior of the sound, formed, when pushed out, two loops crossed, between which he proposed to seize the stone.†

M. Leroy used this instrument before the commissioners appointed by the Academy of Medicine for the Department of the Seine, and was the first who proved by grasping a stone in the bladder of a dead subject, and perforating it, that an operation which before his time had been consi-

* See M. Leroy's work (Pl. III. fig. 2).

† Pl. III. fig. 1 and 3, of M. Leroy's work, represent this instrument; and the 5th figure represents the winch handle.

dered impracticable, was now by evidence rendered practicable.

Experiments, however, made in organs devoid of sensibility, did not appear sufficiently conclusive to M. Leroy; he did not find that he could grasp the stone with sufficient facility, and his destroying power appeared too feeble for the application of this instrument to be attended with any satisfactory results if employed on the living subject. These faults, which he discovered in his first *lithoprione*, induced him to make new trials.

He soon discovered in an old instrument invented by Alphonso Feri, for the extraction of balls, a construction adapted to accomplish the object he had now in view. This instrument was composed of a steel tube, supporting three branches of the same metal, diverging from each other by their own elasticity, and closing again by means of the external tube which drew them together like a slide; this appeared to M. Leroy particularly well calculated to assist in obtaining the object of seizing the stone, which he himself, and especially Dr. Gruithuisen, had only very imperfectly accomplished.*

Modifying first the forceps of Alphonso Feri, so as to make it easier in its application as to grasping the stone, he then made a central

* The instrument invented by Alphonso Feri, is drawn in M. Leroy's work (Pl. I. fig. 13, 14, and 15).

canal through the whole length of the tube which supports the three branches, in order that he might introduce perforators and elastic drills,* which he intended for the destruction of the stone; he fitted to this instrument a *chevalet*† (hand vice) in order to render the action of the bow upon the perforating stylet more efficient, and he then presented the result of his labours to the Academy of Surgery, at the sitting of April the 10th, 1823.‡

Some months later in the same year, a book appeared by M. Civiale, among the last pages of which was the drawing of an instrument that he also intended for breaking down stones in the bladder. This instrument,§ very similar to the one presented to the Academy by M. Leroy, differed from it however in many respects.

---

* For the elastic drills, turn to M. Leroy's work (Pl. III. fig. 6, 7, and 8). The (IVth pl. fig. 9 and 10) of the same work, represent elastic files, by means of which he sought to excavate the stone. But it is easy to perceive that the action of all these instruments must be very inefficient.

† See Pl. III. fig. 4, of M. Leroy's work.

‡ This work then consisted of M. Leroy's instruments, of which there are drawings in his own book, namely:—the forceps (Pl. IV. fig. 11, 12, and 14), the "chevalet" (Pl. III. fig. 4), the perforator (Pl. III. fig. 2), and, finally, the elastic drills and files (Pl. III. fig. 6, 7, and 8, and Pl. IV. fig. 9 and 10).

§ See the drawing of this instrument in M. Leroy's work (Pl. II. fig. 1, 2, 3, 4, and 5), and also in the plates of my letter to the Academy of Sciences.

The branches in M. Leroy's instrument are three in number, and elastic; whilst they are represented in M. Civiale's plate as consisting of four, each composed of three pieces, jointed together by means of bolts. The drill destined to perforate the stone, which in M. Leroy's instrument consists of a simple stylet, having one end armed with teeth, and which as soon as it has made a hole in the stone, is to be changed for elastic drills to enlarge this opening, is, in M. Civiale's drawing, represented as consisting of a metallic rod, like the perforator of Dr. Gruithuisen, having at its end a knob of the shape of a trephine or borer, which by being drawn between the branches makes them expand and keeps them apart; it also at once makes a larger perforation in the stone than the simple stylet of M. Leroy. Besides these differences in the instrument *constructed* by M. Leroy, and the one *drawn* by M. Civiale, the first of these surgeons proposed to turn the drill by means of a bow, with a vice held in the hand, as when he presented his first *lithoprione* to the Academy, and the latter recommends the use of a simple winch-handle, adding however, that the bow employed by Leroy might be used, although the hand answered better.

Although we may suppose it possible to act on the stones in the bladder of the dead subject with M. Civiale's instrument, no minutes of the Aca-

demy record that this surgeon made any trials to prove the utility of his instruments.*

Such was all that, up to the year 1824, perse-

---

* By this statement it will be seen that the right of M. Civiale to the invention of lithotrity (including the method and the means of operating), "méthode et procédé," are by no means evident; nevertheless this medical gentleman has thought he could set up pretensions, which have been the cause of a controversy between him and M. Leroy (D'Etiolle), relative to this three-branched instrument, with which the first operation of lithotrity was performed.

M. Leroy, with the view of establishing his rights to the invention, has published a book, entitled, "*Explanation of the various Means employed up to the present time for Curing the Stone without Incision.*"* In this book, which is very interesting, M. Leroy goes over, with remarkable critical talent, every thing which among the ancients could have led to the idea of breaking up calculi in the bladder. This surgeon sets forth his rights with clearness and method, and renders evident to every just and unprejudiced person that he is the author of the instrument in question, and that M. Civiale is only the imitator.

Having some time ago given an account of M. Leroy's work, in the "Archives de Médecine," and accorded to that surgeon all the justice he merits, M. Civiale put in a claim, but with very little success, as the greater number of French medical gentlemen at present attribute to M. Leroy (D'Etiolle) the invention of the three-branched instrument, "perce-pierre."

Be this as it may, M. Civiale having lost his cause before the generality of men of science, appeals to the public, an incompetent judge in medical matters, and has recourse to daily advertisements in political journals.

The delicacy of M. Leroy forbids his replying to such publica-

---

* This work may be procured at Baillière's, No. 219, Regent-street.

verance and mechanical ingenuity had been able to accomplish towards breaking down and extracting stones from the bládder through the urethra.

---

tions, and I would not advise him to do so, as it would compromise him in the opinion of those medical men who know how to support the dignity of their profession.

Besides, as soon as I became acquainted with the reasons on which M. Leroy grounded his just pretensions, I was called upon to support him, and that so much the more, as M. Civiale, taking unfair advantages of circumstances which enabled him the first to apply M. Leroy's instrument, has endeavoured to thrust himself forward as the inventor, not only of M. Leroy's process, but also of the method of breaking the stone which appertains to the Bavarian physician, Gruithuisen.

There is no doubt whatever respecting the right of this last physician to the invention of the method, as is proved in the historical part of our work, and as will be rendered evident to those who take the pains to read the two papers I have already mentioned: namely, his German manuscript inserted in the Medico-Chirurgical Gazette of Saltzburg, 1813; or the French translation, inserted in my letter to the Academy of Sciences, 1827.

As for the first means employed for breaking up the stone, and the invention of which M. Civiale claims, to the disadvantage of M. Leroy, the following reasons induce me to reject M. Civiale's pretensions, and support his competitor's.

M. Leroy has in his possession the whole series of attempts and combinations by means of which he arrived at perfecting each of his two instruments, of which I convey an idea in the historical part of my treatise, and M. Civiale produces nothing indicative of his having been led by a series of ideas and experiments to the construction of the instrument; he must therefore have constructed it off-hand, and this we consider as next to an impossibility, for we know by personal experience how many attempts and combinations are

Science, although it then only possessed very slender and imperfect means for relieving mankind, had made in this respect very rapid progress.

---

requisite to arrive at the execution of the most simple mechanical idea which has a surgical end for its object.*

M. Leroy had twice performed before commissioners appointed by learned bodies, previously to the performance of the first operation. M. Civiale has never done any thing of the kind; the first time he appeared in the science was when he operated on his first patient. Now, I say again, it is not natural to arrive at such a conception as that of the "perce-pierre," at the first attempt, without preliminary essays.

M. Leroy is known in France by ingenious memoirs, and by other inventions besides that relative to lithotrity. M. Civiale, with the exception of the invention of the process in dispute, and its consequences, has not as yet done any thing to attract attention; this circumstance, although only accessory, induces me to believe that the inventor of the instruments in question is rather M. Leroy than M. Civiale.

Since the invention of lithotrity, M. Leroy has perfected his "perce-pierre," and rendered it more energetic by adding to it

* M. Civiale certainly gives, in his work, a history of the successive ideas which led him to the construction of his "perce-pierre," but were we to give ourselves the trouble, we could give the most convincing evidence that this history is a romance made at pleasure; besides, it is not enough to say that one has made,—the assertion must be proved, and the proofs to be given are the first attempts, similar to those which M. Leroy shews to any one who desires to see them. Besides this, the history of M. Civiale appears to me to be the more inexact, inasmuch as the author takes for the ground-work of his narrative my "pince à forceps," of which he shews one part of the mechanism. I feel truly happy to have proved useful to M. Civiale, in furnishing him with some ideas; for had it not been for my "pince à forceps," his history had been very short.

The introduction of a large straight sound, due to Dr. Gruithuisen, and the perforation of a stone in the bladder of a dead subject, due to M. Leroy,

---

the power of excavating the stone. M. Civiale confines himself to the "perce-pierre," for the attempts he has made to go beyond it, and which he has published in his book, are rather of a nature to display his limited capacities than to give any idea to the contrary.*

M. Leroy acknowledges having borrowed the three-branched forceps from Alphonso Feri. M. Civiale pretends to have designed it. Now it is more natural to believe him who says that he borrows, than him who pretends to invent.

M. Civiale, whom the Academy of Sciences, in a first report, had regarded as the inventor of the process in question, is, in subsequent reports, considered no more than a simple operator, and all the honours of the invention seem, on the other hand, to be accorded to M. Leroy. Now the Academy must have had serious motives for thus retracting their first decision.†

M. Leroy, in his writings, has always displayed candour and frank-

---

* These instruments of M. Civiale are drawn in the third plate of his book, figures 1, 4, and 5.

† The report of Messrs. Chaussier and Percy, in which these two academicians, for want of having sufficiently investigated the question, considered M. Civiale as the inventor of the method of breaking stones in the bladder, is dated 22d March, 1824.

Well, since that period, whenever any thing has been said about lithotrity, in the reports of the Institute, this is the manner in which the members of the commission nominated to take cognizance of it, expressed themselves with regard to M. Leroy.

"In 1825, in the "séance" of 30th May, the Academy made honourable mention of M. Leroy for having invented *lithotritic instruments*, "les instrumens lithontripteurs," for having executed them, and made known successively the improvements which his experiments had suggested to him.

"In 1826, in the month of June, the academy awards a recompense

were facts too conclusive to leave much to be done towards effecting the cure of calculous patients by those means. It was M. Civiale who had the ad-

---

ness, and unfortunately M. Civiale may be reproached with having published instruments which he never employed;* and this circumstance, of which we forbear to mention the details, is, in our estimation, sufficiently important to make us receive with reserve what M. Civiale may think fit to say in his own interest.

On the whole, to put an end to this parallel, so disadvantageous

---

of 2,000 francs to M. Leroy (D'Etiolle), who published in 1825, a work on the breaking up of the stone in the bladder, and who had been *the first* "le premier" to make known, in 1822, the instruments he had invented."

Finally, in 1828, in the report which concerns my own labours, the Academy expresses its opinion still more clearly, in saying, "By means of this procedure, of which the first idea evidently belongs to M. Leroy, already known to the academy as the *principal inventor*, "le principal inventeur" of the lithotritic instruments, but which Dr. Heurteloup has rendered applicable by the power of resistance which he has found the means of giving to his "évideur," stones of considerable size can be attacked and broken to pieces in a few instants." (The Academy is here alluding to my apparatus, "évideur à forceps.")

If now we consider that in 1827 the academy awarded a prize to M. Civiale, merely for having "the first performed the operation of lithotrity on the living subject, and for having applied this new method with success on a great number of patients," there will not remain any doubt as to the opinion of this learned body on the respective rights of Messrs. Leroy (D'Etiolle) and Civiale to the contested invention.

Should any persons still continue to consider M. Civiale as the inventor of the first applicable process for lithotrity, we can only attribute it to the zeal with which that medical gentleman propagated the error in the public papers.

All the reports here quoted may be seen, in part, in the Medical Review, and may be there referred to.

* These are the instruments of which I made mention in a preceding note, and are drawn in the third plate of his work, figures 1, 4, and 5.

vantage of being the first to bring into actual practice the ingenious inventions of his predecessors.

Renouncing all idea of using the defective instrument engraved in his work of 1823, he had an apparatus constructed similar to that presented to the Academy by M. Leroy. Following the ideas of that surgeon, he adopted as the principle of his instrument, the *large straight sound, with the bow and pulley of Dr. Gruithuisen, the forceps and elastic branches similar to those of Alphonso Feri*, and lastly, the *hand vice of M. Leroy*, the advantages of which he had not at first fully appreciated.

Modifying however, this apparatus in its construction, he did not, like M. Leroy, employ a simple perforating stylet, and elastic drill to enlarge the opening previously made, but he retained the drill with the enlarged head, similar to that proposed by Dr. Gruithuisen, and which he had adapted to the instrument he now renounced. He made use of it to expand the branches of the forceps, and to make a larger hole in the stone every time it was laid hold of than could be done by the simple stylet of Leroy; and in 1824, he effected by means of this "*perce-pierre*," which he named

---

to M. Civiale, but which he calls forth with all his might, by the obstinacy with which he persists in his ill-founded pretensions, we will refer our readers to the two competitors themselves, which is the surest method of having a precise idea on the respective aptitude of these two surgeons for inventing any thing.

"*lithotriteur*," the first cure of a calculous patient by this method.*

Such was the state in which I found lithotrity when I commenced my labours; it consisted, as I have already described, of an instrument capable of grasping a calculus, and making a simple hole in it. This instrument must have created surprise and have appeared satisfactory when the first operations were performed, but it was far from meeting the exigencies of this disease; it was sufficient to cure those who only had small stones, but the relief of those who had calculi of some size, either had not been accomplished, although the patients had quietly submitted to several attempts, and the stone had been repeatedly perforated; or if a cure had been obtained, it was only at the risk of all the dangers and accidents which must necessarily result from the slowness of this mode of

---

* This instrument is exactly similar to the "perce-pierre" as seen (Pl. I. fig. 1 and 2 of this work), except an important addition which I have made, consisting in a canal carried through the instrument, affording the facility of injecting water into the bladder during the operation.

I have also modified this instrument in what relates to the performance of secondary indications, by sometimes only having one branch with a hooked extremity, by rounding off the drill; but these alterations being only requisite under certain circumstances, such, for example, as searching for fragments in an irregular bladder, and seizing them, notwithstanding its soft and fungous parietes, cannot be considered as belonging to the "perce-pierre" in its general application.

operating, and from the fatigue of the patient. In fact, from its nature it required the repeated introduction of the instrument, and a repetition of long and painful attempts to search for the stone, and grasp it each time of its being perforated.

To seize a stone, to make *a hole in it*, to *drop it*, to *search* for and *retake it* in the bladder, in order to make another *hole* in it, to repeat this operation until it is broken, and afterwards to submit *each* of these broken portions to the perforation or pressure of the instrument, in order to render them small enough to be expelled—all this certainly appears a slow process, and one often painful in its application.

An instrument capable only of making a simple hole in the stone, appeared to me one of the smallest results that might be obtained by mechanical ingenuity, founded on the possibility of introducing through the urethra into the bladder a tube of three or four lines in diameter. This was, in my opinion, only the first step of science in a new path.

It struck me that the "perce-pierre" was only sufficient when the stone did not exceed, or only slightly exceeded the diameter of the central drill, which was to perforate it, but that it became insufficient in proportion to the diameter of the calculus, which, as it became larger, would require a more frequent repetition of the perforations.

I apprehended, and many experiments after-

wards proved it to me, that this instrument, besides its inefficiency, was not devoid of danger in its application; such for instance as fixing the hooked extremity of one of the branches in one of the holes made in the stone, and that also of engaging one of these hooks in the sinuses existing in some bladders. I was also convinced that the action of this instrument was often very deceitful, from the perforator falling into one of the holes made in a previous attempt. I saw that when the fragments were to be destroyed it too frequently happened that the portion was only grasped between two branches, so that it could scarcely be touched by the drill, which only acts in the centre.*

* This will be the opinion of all those persons who examine the "perce-pierre," with a view of discovering its perfections and defects, and who, in order to ascertain its real value, try its action on stones of all shapes and sizes. I am induced, in the interest of science, to insert in this note, word for word, what was said concerning the "perce-pierre," in the report of the year 1827, by a commission chosen to distribute the prizes of surgery, founded by M. de Montyon. This report, after reproaching the "perce-pierre" with the following defects, confers on me the first prize of surgery for my labours in lithotrity. The report runs thus:—

"Lithotrity, or the art of destroying calculi in the bladder, having been, from its infancy, received with eagerness by the Academy (of France), has already been the object of many of the prizes and rewards which it confers. But whatever be the actual advantages of this novel mode of operating, it is far from having attained that state of perfection which we may reasonably look for, without going beyond the limits of ordinary and moderate expecta-

More labour was therefore required to bring lithotrity to that state of perfection of which it was capable; I devoted myself to the task with

---

tions. Let it therefore be the object of surgeons to remedy its chief defects, which are as follows:—

"1. It necessitates a gradual dilating of the urethra by means of sounds, which sometimes produces accidents of so serious a nature as to prohibit the operation of lithotrity.

"2. It requires that the branches destined to grasp the calculus should be made to project to a considerable extent from the tube which contains them, before there is sufficient expansion to seize the stone. This condition renders the operation inadmissible in cases of small bladders.

"3. It affords ground for apprehension in all cases, and more especially in cases of large calculi, and bladders with irregular parietes, that the coats of the bladder may be pinched between the calculus and the hook of one of the branches, which is liable to entangle in the cavities of such bladders and perforate them.

"4. When the calculus is large, it requires violent manœuvres and a considerable degree of friction of the instrument against the neck of the bladder, in order to place the stone conveniently for its being seized; this is often attended with serious inconveniences, and above all in cases of diseased and extremely sensitive bladders.

"5. Its destructive action on the calculus is limited to a simple perforation no larger than the drill head, this action must, therefore, be frequently repeated before the stone can be broken; and, consequently, requires a more or less frequent repetition of the operation. When a calculus has been perforated in many places the action of the instrument is often quite fruitless, for when the drill is rotated, it enters into one of the holes made previously, and the stone is thus sometimes left entire, although perforated in many parts of its circumference; this circumstance has often compelled surgeons to abandon the operation of lithotrity, after having acted

ardour, and sought to overcome those difficulties in surgical mechanism which would lead me to this important object.

---

on the calculus by numerous perforations. Experience has also taught us, and it is easy to conceive, that these holes fill rapidly with fresh lithic depositions.

"6. During the rotation of the drill by means of the bow, the patient is liable to experience painful shocks, on account of the instrument only being maintained by the hand of an assistant.

"7. It often allows the foreign body to escape from the grasp of the forceps, and thus renders useless all the researches and manœuvres which its seizure demanded.

"8. It exposes the surgeon to entangle one of the hooks of his branches in one of the perforations made in the stone, which would hinder him from withdrawing the instrument; this accident has not yet happened on the living subject, but having once been met with whilst making experiments on a dead subject, it is right to notice it.

"9. Its action is in general far too tedious, either on account of the numerous operations required to break a calculus, or else from the necessity of going through the same proceedings for comminuting each one of the fragments, as for breaking the stone itself.

"Dr. Heurteloup, who has already been honourably rewarded by the Academy for the perfection to which he has carried his instruments of lithotrity, has remedied most of the above-named defects," &c. &c.

M. Civiale has thought proper to cast certain reflections on the judgment of the Institute, in defence of the "perce-pierre," but all his reasoning can never add to the action of this instrument, which consists in making a simple hole, and the faults which the Academy discovered, especially in its action on calculi, and in the dangers resulting from this action, subsist in all their evidence. The author of the reflections ought to have considered before he made them, that men, such as formed the commission of an Aca-

I considered that if instead of breaking the stone by repeated perforations, I could devise some means of gradually and progressively enlarging a hole previously made, I should succeed in destroying the calculus at once, and by only seizing it once in the bladder; the centre being thus excavated and reduced to powder, the rest of the stone would fall in the form of a shell.*

I considered also that if after having reduced the stone to this shell, I could invent an instrument capable of crushing these flat and concave frag-

---

demy, only gave their opinion on the worth of the "perce-pierre," after a deliberate examination, and ocular evidence; and it is impossible to be deceived in a mechanical action, such as that of the "perce-pierre;" we may, however, further add, that the opinion of the Academy would have been far more disadvantageous for this instrument, had the commission examined its action on oval and more especially on flat calculi.

I will also remark, that M. Civiale prudently avoids this subject. He is well aware that the "Institut" is alluding to the action of his instrument on calculi which can only be destroyed by several perforations, and not to its action on small stones; M. Civiale, on the contrary, has founded all his argument in defence of the "perce-pierre," on its action on small calculi. To these arguments we did not think it necessary to answer when they first appeared.

* The original idea of excavating the stone is, as we before stated, due to M. Leroy (D'Etiolle), but the elastic files he intended for this purpose, act very inefficiently on the calculus. The primitive idea might have been entertained by many persons; the difficulty, which I have been able to surmount, was to put this idea into execution.

ments with facility, as soon as they were taken, and without much time being spent in manœuvring, I should then have completed a system of destroying vesical calculi, which approached as near as possible to perfection; for on the one side I should have found the most rapid means of destroying whole stones and reducing them to fragments, and on the other, of again reducing these fragments sufficiently, for them to be easily expelled through the urethra.

I considered also, that if instead of operating with the patient on a common bed, on which he is always inconveniently situated, both for himself and the surgeon, I placed him on a small bed, expressly constructed in such a manner that he might lie at perfect ease, and if at the same time I was able to alter the position of the pelvis at will, I thought I should proceed more conveniently with the destruction of the stone, and should add to the chances of success all the advantages resulting from a position convenient both to the patient and to the surgeon; and lastly, I considered that if I could contrive some method of holding the instrument during its action upon the stone, more firmly than by the *chevalet* proposed by M. Leroy, I should add still more to the improvement of this art, as without a firmer support than the *chevalet*, held in the hand of an assistant, my system of excavating the stone was impracticable.

I have by degrees achieved all these objects,

and with sufficient success to have obtained several rewards from the "Institut de France," and particularly the great prize of surgery for the year 1828.

Thus in the first place I have substituted for the "perce-pierre" which only destroys calculi of a certain size, by making *repeated* perforations in them, and which requires *frequent* attempts and *much* searching in the bladder, a system of excavating, which only requires the stone, especially when nearly spherical, to be once seized, in order to break it into pieces.*

Secondly, I have advantageously substituted for the same instrument, another peculiarly well adapted for destroying flat or concave fragments resulting from the action of the excavating instruments, and flat stones, which from their shape are extremely unfavourable for the "perce-pierre."

Thirdly, I have advantageously substituted for the inconvenient position of the patient on a common bed, a position which may be altered and adapted at will to the comfort of the patient, and the convenience of the surgeon, and *ceteris paribus* renders the operation more expeditious and more gentle.

* The "trois branches à virgule" is used for spherical calculi of from 8 to 12 lines in diameter; and the apparatus "évideur à forceps" for those of from 12 to 24. (The former of these instruments is represented Pl. I., and the other Pl. II. of my work.)

Fourthly and lastly, I have advantageously substituted for the unsteady support of an assistant to maintain the instrument during the operation, a firm and immoveable "point d'appui," (fixed point,) useful when operating with the "perce-pierre," but indispensably necessary when operating with my excavating instruments.

Such is a most concise sketch of the four principal objects I have had in view. These, added to some new ideas with regard to the accessory treatment, such for instance as ascertaining the form of the bladder and stone before commencing the operation, that of injecting, that of producing the expulsion of the fragments from inert bladders, or the extracting them when lodged in the urethra, the means of discovering small stones or fragments in the bladder by a different method from that generally pursued, complete all the lithotritic apparatus of which I am the inventor. The means by which I have been enabled to accomplish all these objects will be explained in the course of this work.

Thus it will be easily perceived from this sketch, which I have endeavoured to render as concise as the subject would allow, that my mode of operating does not consist in the employment of one single instrument, which, however perfect, can never be equally applicable to stones of all shapes and sizes, but that it consists rather in the application *of a particular and competent system of means, the dif-*

ferent parts of which are applicable to different cases.

If we reflect on the nature of lithotrity, and consider under what a diversity of circumstances patients present themselves to be submitted to the operation, as regards the concretions to be destroyed, and the organs in which their destruction is to be accomplished, it will be readily conceived that a great variety of means must be indispensably required to perform lithotrity well.

Again, if we remark that the success of the operation depends upon the prompt and energetic action of the instrument on the calculus, in order that the number of attempts may be as few as possible, and on the delicacy of the manœuvres, we shall readily understand that any method which will lessen the number of attempts and the painful sensations of the patient, which invariably result from long searching for the stone, will be an admirable and invaluable change in our art.

I shall endeavour to shew in this work that all my endeavours have been to obtain this object; the instruments, the double combination of their action to seize and break down the stone, the mode of proceeding in the operation, the position of the patient, the possibility of changing that position, the firmness with which the destroying agents of the stone are maintained, and lastly, the different means of meeting those secondary circumstances which I have mentioned, and which

often become more important in certain cases than the pulverization of the stone itself.

In writing this work I have communicated, as far as possible, the knowledge I have been able to acquire by the researches I have made in lithotrity. After having in some degree extended the means of this new art, I feel it my duty to endeavour to diffuse that knowledge, with all its attendant considerations, both with regard to the organs to be operated in, and the method of performing the operation.

This is what I am about to undertake, and before entering upon the subject I shall give a sketch of the different parts of which this book will be composed.

I shall commence by examining the organs in which we are to operate, for it is their form and dimensions which regulate the form and dimensions of the instruments of lithotrity.

In the second division I shall treat of calculi, and shall consider them with regard to lithotrity; consequently I shall explain their physical conditions, and I shall particularly describe the first symptoms by which the existence of a stone may be detected.

In the third division I shall describe the construction of the instruments calculated to destroy calculi: these will be divided into lithotritic instruments, properly so called; that is to say, those which are destined to break down the stone; into

accessory instruments, which are destined to accomplish secondary indications; and into instruments, which are destined to support the patient, and to hold the lithotritic instrument during the operation. In this chapter I shall give those details which will shew the motive for which each instrument was constructed; I shall explain the mechanical construction of each, and its action upon the stone: this examination will be made separately and independently of all connection with the organs in which they are brought into action.

In the fourth division I shall treat of the circumstances which may add to the success of the operation, or which may render it difficult, or altogether inadmissible.

And lastly, in the fifth division, which is confined to the consideration of the operation, I shall describe the instruments in relation with the urinary organs, and with the calculi. I shall also treat of what the surgeon has to do *before the operation, during the operation, and after the operation.* All the manœuvres will be explained, and the surgical part of lithotrity will be taught, and in that part which treats of what is to be done before and after the operation, the medico-chirurgical part of the treatment will be shewn.*

Lastly, I shall conclude my work by some un-

* This division, from its nature being very extensive, will constitute the second volume of my work.

connected observations: some in the form of reflections, some in the form of discussions, others in the form of aphorisms, and lastly, others as notes for the purpose of elucidating some parts of the work.*

It is probable that at some future period these observations may be better arranged in the body of the work, but at present I publish them separately and without arrangement, just as they are suggested by the subject; perhaps some will be found sufficiently important to raise some questions of interest, and with this idea I consider it useful to add them to the present work.

---

* These observations will be inserted at the end of the Second Part of this work.

THE

EXAMINATION

OF THE

URETHRA AND THE BLADDER,

AS REGARDS THEIR CONNECTION WITH

LITHOTRITY.

These organs, examined in a purely anatomical point of view, are already so well understood as to render it unnecessary to say any thing respecting their structure. It is not my intention to give the descriptive anatomy of these parts, which would lead me too far from my present purpose, but simply to direct the attention to those points which may throw some light upon our subject.

Before it was known that it was possible to introduce with facility a large and straight instrument into the urethra, in order to examine the bladder, or to seize and break any substance contained within its cavity, it was doubtless of little importance to study these parts further than to have a general idea of their internal structure; but now, when the aim of science is to produce a

cure in those suffering from stone, without having recourse to the operation of lithotomy, it is evident that such being our object, a more minute examination of these organs is indispensably requisite.

In order to do this with greater advantage, we shall employ not only our anatomical knowledge, but also those data which we have acquired from our operations, and which have led us to a knowledge of the action and structure of these organs, at the very time of their acting. It is necessary to join these two elements of study together, for separately they would lead us to imperfect and incorrect conclusions. The surgeon practising lithotrity ought to be well acquainted with the internal form of these hollow organs, and also with their size; anatomy teaches us both the one and the other, but as these two physical conditions are considerably modified by the effect of the contractility of the urethra and bladder, it follows that the anatomical examination is not alone sufficient, but that we must add to it the study of those laws which influence the contraction of these organs. This manner of considering the bladder and urethra, will oblige me to use sometimes the words *absolute size and form*, to mark the capacity and form these organs possess, independently of their contraction, and at other times the words *relative size and form*, to mark the form and size of these organs when under the influence of contraction.

ON THE URETHRA.

VIEWED by the surgeon who practises lithotrity, the urethra is destined to two purposes; first, to allow of the introduction of those instruments which are calculated to crush the stone, and secondly, to allow of the passage of the broken fragments from the bladder.

We will therefore examine this canal in its relation with a straight sound, and with fragments of stone, taking for our model the healthy and well-formed urethra of a male adult, in the horizontal position, that is, lying on the back.

If after removing the urinary system from a subject in whom these organs are healthy, we lay open the urethra from its orifice to the neck of the bladder, we shall perceive by the width of the exposed mucous membrane, that this canal is in the whole of the anterior part, nearly twice as wide as it is in the posterior portion, which appears very much contracted, particularly those parts of it which have been named *the membranous and prostatic portions.*

On the contrary, if on the living subject we introduce a straight sound of that diameter which the anterior part of the urethra admits of, the instrument at first passes slowly, but when its extremity reaches that portion of the canal immediately beneath the symphysis of the pubis, it passes with the greatest ease, and is as it were drawn

into the bladder without the assistance of the surgeon, except in as much as he must keep the instrument parallel with the canal, and its extremity in that position most suitable for its introduction.

From this it appears that there is an evident contradiction between our anatomical and our practical conclusions; anatomy shewing us that the anterior part of the urethra is larger than the posterior, practice on the contrary giving the sensation of greater width at the posterior portion.

If we seek for the cause of this phenomenon, we shall find it in the different organization of these two parts; we shall perceive that the posterior portion is formed of a fibro-muscular tissue, which is peculiar to it, and which is susceptible of being dilated or contracted; independently of this it has a powerful muscular apparatus to assist the contraction; hence it follows that according as these fibro-muscular, and muscular tissues dilate or contract, the mucous membrane is dilated or contracted, and lines a canal sometimes larger and sometimes smaller than the anterior part of the urethra.

If, on the contrary, we search for a similar structure surrounding the mucous membrane which lines the anterior part of the canal, we shall find very little of this fibrous tissue, and that the only muscle connected with it is the *accelerator urinæ*, which is destined to compress slightly this part of the canal, and which, besides, only enters

completely into action during the erection of the penis, when its attachments have sufficient purchase to allow this action to take place.

From this arrangement we are led to conclude: that it is the anterior part of the canal, which, in the generality of cases ought to give the measure of its absolute size, and that when we have with facility introduced a large sound into this portion of the urethra, we may conclude that it will without difficulty pass through the remainder; that if it does not do so with facility, it is not because the canal is not large enough, but because there is more or less muscular contraction in some part of it.

Now, the absolute size of the urethra in the adult, is from three lines and a half to four lines, and we can estimate its calibre by measuring the anterior part with a cylinder; it however often happens that at the first attempt we cannot ascertain the size of this part of the urethra, because its orifice, known by the name of the *meatus urinarius*, is sometimes small, although the canal itself be very large, and this prevents our at once appreciating the chance of success which a large canal can give to the operation of lithotrity.

Two anatomical dispositions contribute to contract the orifice of the urethra; first, we remark that this contraction may be caused by a fold of the mucous membrane, which unites the two lips of the meatus at its inferior angle, and according as this fold is large or small, so is the entrance of

the canal: this is sometimes the only cause; but it occasionally happens that this membrane being divided, the orifice is no larger, and does not allow us to estimate the size of the urethra below the meatus. The additional obstacle is a kind of projection, formed by the two extremities of the erectile tissue which composes the glans penis; this, in some, projects considerably into the urethra; in others, though not so evident, still it impedes more or less the free introduction of the sound into the canal. It is on this projecting point that the sort of sensitive *sentinel* is placed, which warns the healthy person of the desire to void his urine, and the patient of the presence of a stone in his bladder, or of an inflammation of this organ; and it is this point which sympathizes in the affections of the other extremity of the canal.

The knowledge of this form of the meatus urinarius will afford us some useful precepts, which will be of service in those cases in which it is necessary to enlarge this opening.

The urethra is nearly of the same diameter from the orifice to its membranous portion; it however enlarges a little as the bulb increases; near the termination of the bulb, it presents, at its inferior part, a depression or kind of *cul de sac*, which becomes the more evident the greater the contraction of the membranous portion, which is close behind it: when the fibro-muscular tube, which forms this membranous portion is relaxed, there

is very little *cul de sac* of the bulbous portion, and the urethra is of the same diameter throughout its whole extent—at least this is the sensation which this portion of the canal gives on the introduction of a large straight sound. Immediately behind the *cul de sac*, we have the membranous portion, eight or ten lines in length, of the same diameter throughout, composed of a fibro-muscular tissue, which contracts very powerfully, its office being to expel the semen in the act of coition. Physiology teaches us that this membranous portion has the power of dilating to receive the semen, as well as that of contracting spasmodically to expel it with force, so that according as this portion is in one or other of these two conditions, it becomes the largest or smallest part of the urethra.

From the membranous portion of the urethra to the neck of the bladder the canal gradually increases in size: this is the part named by anatomists the prostatic portion; if we consider its absolute size, we should suppose that the instrument ought to pass it with ease after having traversed the membranous portion, but there are some circumstances which may prevent this, and which are in fact sometimes met with. This part of the urethra forms a cone, the larger opening of which is turned towards the bladder, and the smaller forms a continuation with the membranous portion. In the middle and lower part of this cone is that fleshy eminence named the *veru montanum;*

but this is seldom sufficiently large to impede the progress of the sound, and besides it may be easily depressed when the third lobe of the prostate, which sometimes exists, is not enlarged.

A greater obstacle presents itself in that kind of *cul de sac* which terminates the prostatic portion nearest the bladder; this may impede the progress of the sound, and does so the more frequently in proportion to the small diameter of the instrument, and from there being two other additional causes which add to this difficulty.

There is often above the margin of the *cul de sac*, which forms the lower part of the neck of the bladder, a kind of fold of the mucous membrane, in the form of a crescent, and more or less developed in different individuals. This fold, which is a sort of valve, forms the posterior boundary of the *cul de sac*, and of course renders it deeper the more it is developed.

Besides this mechanical impediment which is still more augmented by the slight curve which the canal makes at this part, the introduction of the sound may be also impeded by another circumstance, namely, the contraction of the circular fibres of the neck of the bladder, and still more directly by the contraction of those muscles which give these organs the motions required for the due performance of their physiological functions. The levator ani muscle may, by the contraction of its anterior fibres, oppose the introduction of

the straight sound, its action being to raise simultaneously the sphincter ani and the prostate; thus, when it contracts, it draws the gland up, and compresses the lower part of the canal against the upper, by which means it is contracted, not as in the membranous portion by a circular constriction, but, by being as it were in some degree flattened, which hinders the introduction of the sound.

Thus, after taking into consideration the obstacles which the internal structure of the urethra, and the laws which influence the contraction of its different portions offer to rectilinear catheterism, we see that, in the generality of cases, when the urethra is in a perfectly relaxed state, a straight sound of three or four lines in diameter ought to pass with facility.

Let us now examine if the manner in which the urethra is connected to its surrounding parts is not worthy of some attention.

From the meatus urinarius to within about two inches of the arch of the pubis, the urethra is free and unconfined, accompanied at its upper part by the corpora cavernosa, which proceed to the rami of the pubis, in contact at its lower part with the integuments, and terminating at the glands, it forms in conjunction with these structures the penis, which in its relaxed state may be moved in any direction. But when the penis reaches even with the middle of the symphysis,

it is connected to the surrounding parts; by which means the urethra is partly fixed, and it is important to study the different degrees in which this takes place, in order to estimate the degree of mobility which a straight sound, introduced into the bladder, may enjoy.

The penis, composed of the urethra and corpora cavernosa, adheres by means of the surrounding fibrous tissue, to the anterior part of the symphysis and of the triangular ligament, but this adhesion does not immediately include the urethra, as the corpora cavernosa are placed between it and the symphysis.

This structure is advantageous, for if the urethra, instead of being placed beneath the corpora cavernosa, was placed above them and adhered to the symphysis, rectilinear catheterism would be impossible; for we are only able to accomplish it, because the urethra being placed beneath the corpora cavernosa can, by the straight sound, be brought to the level of the symphysis, for the corpora cavernosa, although attached to the anterior part of the symphysis by the suspensory ligament, yield sufficiently. This is the reason that, when the straight sound arrives under the symphysis and is depressed in order that its axis may become parallel with the remainder of the canal, the penis becomes flattened laterally, for the corpora cavernosa and even the urethra itself are more extended, and must yield the more, the

nearer we find them inserted to the upper part of the arch of the pubis, and the less laxity there is in the suspensory ligament.

Now, as the urethra quits the corpora cavernosa about an inch before it adheres to the triangular ligament, notwithstanding the size of the suspensory ligament, the depression of the instrument is rendered easy by the laxity of the cellular tissue, which at this spot unites the urethra to the corpora cavernosa.

The introduction of a straight sound into the canal, alters its direction in that portion which corresponds to the suspensory ligament, to such an extent, that we may conclude, by simple inspection, that the patient who has the penis much drawn up against the pubis, will offer some difficulty, and experience a painful sensation during that period of the introduction of the instrument, which consists in depressing it sufficiently for it to be in the same line with the remainder of the canal. When the corpora cavernosa have an extensive attachment along the symphysis, and when the part of the triangular ligament through which the canal passes, is situated low down, and the tissues by their rigidity relax but little, it is difficult to give the sound the depression we are speaking of.

Arrived under the symphysis, the canal leaves the corpora cavernosa which are inserted into the rami of the pubis, and continues its course

from above downwards and slightly backwards; it follows the direction of the triangular ligament, through the centre of which it passes, and is so firmly adherent to that kind of hole which perforates the ligament, that it is more correct to describe the fibrous tissue which surrounds the canal and that of the ligament as blended together.

The canal is by these means fixed where it passes through the triangular ligament, and can neither be elevated, depressed, or moved laterally. We are unable to move the straight sound, and all that we can accomplish is to make it turn as on a pivot, directing the point in any direction, either upwards, downwards, to the right or left, while that part of the instrument corresponding to the triangular ligament, always remains in the same place, and the two extremities move in a contrary direction; for the extensibility of the proper tissue of the urethra, and that of the edges of the triangular ligament, notwithstanding its great strength, allow of some depression.

Thus then there are many causes which render it difficult to pass this part of the urethra, first, it is exactly the spot where the bulbous portion of the urethra ends, and consequently where we find that *cul de sac* before mentioned. It is the spot where the membranous portion of the urethra, which contracts so powerfully, commences, and lastly, it is the spot where the canal is surrounded

by the aponeurotic circle formed by the triangular ligament of the symphysis, and against which the point of the sound so frequently strikes.

Now that we are acquainted with those circumstances which may impede the passage of the sound in front of the symphysis, let us turn our attention to what may affect its progress behind that part.

The distance between that portion of the canal which is surrounded by the triangular ligament, and the neck of the bladder, is not more than sixteen or eighteen lines, and is formed by the membranous and prostatic portions. The membranous portion is nearly free from any attachments, but the prostatic portion is in immediate contact with the prostate, and mediately with the levator ani muscle, and the pelvic fascia, which from their connection with the prostate and neck of the bladder, restrain the movement of this gland during the introduction of a straight sound. With regard to the levator ani muscle, we know that many of its fibres are attached to the sides of the prostate, which, varying in size in different subjects, surrounds the vesical extremity of the urethra, and the neck of the bladder, and even sometimes when enlarged reaches under the fundus of that organ, so that we find this part of the canal, as it were suspended by the fibres of this muscle, which by its contraction raises the anus, the prostate, and also the urethra.

The canal, although surrounded at this spot with very dense organs, and very closely connected to the bladder, of which it assists in forming the neck, can nevertheless be moved sufficiently to allow the extremity of a straight sound, introduced into the bladder, to be moved in every direction in the interior of this organ, without producing any inconvenience. We see that this desirable circumstance results not only from the organs themselves admitting of a limited movement, but also because they allow of being depressed or directed equally to the right or to the left towards the pubis or towards the rectum; it is true that this is only to a certain extent, but if the canal was held as firmly and as fixed near the bladder as it is in its passage through the triangular ligament of the pubis, the movement would be more restrained, and consequently the operation of searching for and seizing the stone or fragment, would be rendered much more difficult.

The possibility of introducing a straight sound into the bladder, proves that the different parts of the urethra may be brought to a straight line, and that the modification thus caused is not very considerable. It is drawn a little down at the suspensory. ligament; in the remainder of its extent there is no alteration, for the penis in front of the pubis being with facility moveable in any direction, the canal can be easily brought to a straight line. Behind the pubis the remainder of the canal is

naturally straight, except the slight curve in the prostatic portion, which causes the straight sound to depress the neck of the bladder to a trifling degree; but these inflections of the canal are so slight, and the canal itself yields so readily, that they are scarcely perceptible to the surgeon who practices rectilinear catheterism in a well-formed subject.

If the straight sound, after being introduced into the bladder, be left to itself, it remains nearly horizontal, forming with the horizon, an angle of from 18 to 20 degrees.

We have thus pointed out those circumstances, to be taken into consideration with regard to the urethra, as respecting its internal structure, its course, its relation with the organs which surround it, and we shall apply these *data* when we lay down the rules for practising rectilinear catheterism.

Let us now say a few words concerning the urethra as it regards the fragments. When the action of expelling the urine from the bladder takes place, in a healthy individual, the prostatic and membranous portions of the urethra dilate, and thus offer a large opening to receive the stream; the anterior part obeys almost like an inert tube to the quantity of urine which forces itself into the canal, and the function is better accomplished the more fully the urethra is filled and dilated. It is probable that nature, in order

to assist this distension, made the urethra smaller at its anterior extremity than elsewhere.

But this active dilatation of the urethra does not take place to an equal degree in every subject, and more especially in those who have stones or fragments in their bladders, for the canal does not distend sufficiently to allow of the free passage of the urine, except there is more of this fluid enters into the neck of the bladder, than can escape at the meatus; hence it follows that if the neck of the bladder does not open sufficiently to allow a large flow of urine into the urethra, the distension will not take place, or only in a very imperfect manner, and this is in fact what generally occurs. If we consider that the canal most commonly fills gradually, and that the stream of water does not acquire its full size for some seconds after it commences to flow, we may conclude that the neck of the bladder does not dilate entirely until a sufficient quantity of urine has already passed it, and it has, as it were, become accustomed to the presence of this fluid. Now, if, in the natural state, when there is neither stone nor fragment in the bladder, the urethra, in order that the membranous and prostatic portion may dilate sufficiently, requires to be accustomed to the passage of the urine, it follows that there will be greater difficulty in its complete dilatation when stimulated and excited by the presence of a fragment. Thus we see that those who have a

fragment of stone in contact with the neck of the bladder, do not in general pass their urine in a full stream. The stream indeed is often of a certain size, but evidently not so full as if the neck of the bladder were freely and widely dilated. Hence this disposition of the neck of that organ which allows it to dilate for the urine to pass, and to contract on the approach of a fragment, modifies in a very important degree the easy passage of the fragments. However, this difficulty which the neck of the bladder offers to the passage of fragments, though it appears disadvantageous at first, yet, if duly considered, presents on the other side a great advantage; it prevents those fragments which are too large from entering the canal, and becoming entangled in the urethra: a circumstance which would give rise to measures at all times disagreeable.

Although it may happen that, when the urine is expelled freely, the fragments, if they are sufficiently minute to pass the neck of the bladder, are carried along by the stream of water, traverse the canal as through an inert tube, and are immediately cast out; yet if this expulsion is not sufficiently free, and the fragment, instead of getting into the stream when it commences to flow, only passes in just before the water stops, it may be impeded in some spot of the canal, which retains it more or less securely according to its degree of contraction, or according as the part is *absolutely*

smaller. Generally a new flow of urine relieves the patient; sometimes, however, the canal contracts upon the fragment, and retains it, but dilates sufficiently for the urine to pass.

The canal, like the neck of the bladder, possesses the *elective faculty* of retaining the fragments, and at the same time allowing the urine to flow. This *election* being a phenomenon dependant on sensibility, will lead us to lay down some useful rules to aid the expulsion of the fragments. Now, in considering the urethra with respect to its absolute capacity, that is, entirely devoid of contraction, the fragments traverse the canal, more or less rapidly, according as the part through which they pass is of greater or less diameter, or according as it is directed upwards or downwards; thus, they are frequently lodged at the entrance of the neck of the bladder, but seldom remain in the prostatic portion, which is large, and allows them to pass rapidly to the membranous portion, and the more so, as, when the patient is standing, the direction of this prostatic portion is from above downwards; they often lodge in the membranous, but quickly traverse the bulbous portion, which, although directed upwards, is the largest part of the urethra; lastly, they may be stopped according to their size, nearer or further from the meatus, for the urethra from the bulb to the meatus generally diminishes in size.

When the fragment is stopped in the canal, its

progressive motion, towards the extremity of the passage, is produced either by the propulsion given to it by the stream of urine, or by that expulsive contraction which the whole of the canal possesses, and which belongs to its physiological structure; fortunate are those patients in whom it is well developed, and more especially those in whom there is only a slight degree of spasmodic contraction. When we treat on the passage of the fragments, we shall apply the generality of these considerations to practice. Let us now proceed to the examination of the bladder.

ON THE BLADDER.

This organ has not been so well studied as its excretory canal. The surgeon, being often called upon to restore the diminished calibre of the latter, or to extract some foreign substance accidentally obstructing the passage necessary for the stream of urine, must be well acquainted with the structure of a part, the action of which he may have to regulate; but being never called upon to perform any delicate operation in the bladder, he need only study it superficially: it was sufficient to know that it was a hollow membranous viscus, when persons afflicted with the stone could only be relieved by means of an incision. But now that the surgeon wishes to make use, in this organ, of mechanical instruments of sufficient power to destroy concretions, sometimes extremely hard and

of considerable size; now that he wishes to search for, and to seize these foreign substances, however small they may be; now that he requires this organ to expel, by its contraction, the powder and fragments which result from the action of his instruments upon the calculi, he must study more deeply the form, and the laws which govern the action of that organ, in which he is to exert all the resources of his skill, and all the delicacy of his tact. He must study the bladder well, for it is its form and its proportions, as we have already remarked, which are to regulate the form and the proportion of those instruments destined to destroy vesical calculi. Let us therefore enter upon this study.

When we examine the bladder on a dead subject, and when the organ is quite empty, we remark the following circumstances. Having removed the small intestines which dip down and fill the cavity of the lesser pelvis, we see that this cavity is empty, and that its walls are smooth and lined with the peritoneum; that this membrane after lining the posterior surface of the abdominal parietes, descends into the pelvis, covers the bladder, and reascends upon the rectum, upon the concavity of the sacrum, and upon the sacro lumbar symphysis. If we examine the disposition of this cavity thus lined with the peritoneum, we remark first, at the bottom and on the median line, the projection formed by the termination of the rectum, according

as this latter is of greater or smaller size. We can hardly discover where the bladder is, for it lies close behind the pubis, and its posterior part is compressed against the anterior, so that it forms a kind of flat disk about six or eight lines thick, and from two inches and a half to three inches in each diameter. We can accurately ascertain all its dimensions, by examining it with the hand, through the peritoneum; we feel that we can move its anterior upon its posterior part, and are sensible of the friction of the two portions of its mucous membrane against each other, they being in contact. If we carry the finger some lines above the centre of the disk which the bladder forms, we feel distinctly a depression, and this depression is the neck of the organ.

If, in this empty state of the bladder, we introduce a straight sound by the urethra, the extremity of the instrument will project at the *superior third of the vertical diameter of the disk formed by this viscus*. If we pass water into this organ, when it is empty, we remark the following circumstances. After having injected about four ounces of fluid, the posterior portion of the bladder gradully recedes, more especially at its lower part; at one or two ounces it still remains flat, at four ounces it begins to become round, but at the expense of its posterior disk, which is distended more freely at the lower than at the upper part; it then forms behind the pubis, a hemisphere, the convexity of

which is turned towards the sacrum, the lower part of this hemisphere rests upon the extremity of the rectum, and the peritoneum prevents our distinguishing the boundary of it. If we inject still more water, we find that it enlarges in proportion; that at its upper part, it raises up the peritoneum, whilst at its lower part, it pushes it back towards the sacrum, so that this membrane forms a pouch, or cul de sac. The small intestines, which are situated in the lesser pelvis, begin to be compressed against the sacrum, and are also partly forced out at the upper opening of the pelvis.

When the bladder contains from eight to ten ounces of water it is fully distended, and most resembles a sphere; its coats are already considerably extended, but it does not fill the cavity of the lesser pelvis; it is distended at its lower part only to that degree which its peritoneal covering allows, and is not impressed upon the sacrum, being so bound down by this membrane that it cannot reach so far; it only rests upon this bone about an inch above its union with the coccyx; its highest part is then level with the superior opening of the pelvis, but it does not nearly fill the whole space of this opening. Being placed between the pubis and the peritoneum, which latter keeps it in contact with the symphysis and the parietes of the abdomen, it rises in that direction, and leaves between it, the lumbar symphysis, and the two superior thirds of the sacrum, a wide

empty space, which is occupied by the mesorectum, the intestine which this peritoneal fold contains, and the small intestines which can never be entirely forced out of the pelvis. If we continue the injection, the bladder after it reaches level with the superior opening, begins to alter its form very considerably; it is not distended any more at its lower part, for here, its parietes are bound down by the peritoneum, which prevents its pressing upon the viscera contained in the pelvis; it therefore only becomes enlarged at its upper part, and if we have taken care to leave the parietes of the abdomen untouched as high as the umbilicus, we shall perceive that the bladder, when very much distended, mounts up between the abdominal parietes and the peritoneum, and that the more it is distended the more the upper and posterior parts become flattened by the pressure of the peritoneum. When the bladder is thus distended, it exactly resembles an egg, the smaller end of which is directed upward, and its axis almost perpendicular. If we now raise the abdominal parietes, keeping them as nearly as possible in their natural position, only separating them sufficiently to allow the introduction of the hand, we shall perceive that the bladder in thus mounting up between the abdominal parietes and the peritoneum, forms this membrane into *an inclined plane, the line of which commences in the middle of the space between the umbilicus and pubis, and descending, terminates at the*

centre of the concavity of the sacrum. This leaves in the cavity of the lesser pelvis, a space of some size, which we have already mentioned, and to the consideration of which we again return.

If we press the mass of intestines down towards the pelvis, we remark that *they glide easily between the sacrum and the bladder,* on account of the inclined plane which this latter organ forms by being bound down by the peritoneum. After having thus fully distended the bladder, if we allow the water to pass out, we perceive that the organ again becomes round, that it no longer forms so great an inclined plane for the intestines, which now press more upon that part which faces the diaphragm, than on that which corresponds to the sacro lumbar symphysis, and upper third of the sacrum.

Now, if we examine the bladder, after having opened its posterior part, by a longitudinal incision, from above downwards, and after having entirely removed the water which it contains, we shall perceive that its neck, or rather, that species of infundibulum, which is called the neck, is at *the centre of a nearly flat and perpendicular wide surface;* when we draw the two divided edges of the bladder towards the sacro lumbar symphysis, we shall perceive that the part of the viscus, which encircles the neck, is adherent to the surrounding parts in a radius of nearly an inch and a half, taking for its centre the opening of the neck; we shall find that, by this movement, we can draw

forward all the mass of parts situated in the perineum, and that notwithstanding this dragging, the neck always remains the central point of a circular flat surface, and is not found *as at the apex of a cone.**

If through the opening we have made, we examine the bladder, with the finger introduced into its interior, we feel that we can depress the neck, and draw it back to the extent of eight or ten lines; if we introduce the finger into the interior of the neck, until it is compressed by its parietes, and then draw it towards the concavity of the sacrum, we shall find that the neck may be brought forward into the interior of the bladder, till it becomes the summit of a pyramid, with a large base, composed of all the surrounding parts of the bladder, and which we described as being adherents to the different structures which form the perineum. If we carry the finger under the neck of the bladder, along the median line, we feel the slight projection formed by the prostate, when of of its common size; and beneath we feel the commencement of the rectum, which, even when empty, can easily be distinguished through the coats of the organ. We can with facility depress the bladder at that part where the prostate adheres,

* See the plate in M. Civiale's work, which represents the bladder having the disposition of a *cone;* with so inaccurate a knowledge of this organ, it is not surprising that this surgeon could not comprehend my ideas on the mode of practising lithotrity.

but not so readily its lateral portions, where we find two considerable depressions, which, uniting at the median line, form beneath the neck of the bladder an oval cavity of some size, and which becomes more evident, the more forcibly we draw the divided edges towards the sacrum. We have named this cavity, the upper margin of which corresponds to the direction of the ureters, *the oval cavity of the bladder*. It ought to be well attended to by the surgeon lithotritist; for when it is very large, the stones may be lodged in it, and thus removed beyond the reach of his instruments, especially in the horizontal position. We feel at the upper part, above the neck of the bladder, and on the median line, the firm symphysis pubis; but between the neck and the under part of the symphysis, the bladder may be depressed to some extent; this is the spot which corresponds to the triangular ligament through which the urethra passes. The distance from this ligament to the neck of the bladder is from ten to twelve lines, and there is between these parts a considerable quantity of loose cellular tissue, which renders the extensive depression at this part so easy. Laterally, and at the upper part, we have the obturator foramina, and corresponding muscles, and lastly, by the side of the neck of the bladder, we have the rami of the pubis, and the anterior part of the levator ani muscle. The bladder is only separated from all these parts by the pelvic fascia, to which

it adheres by a cellular tissue, more or less lax, according as we examine it further from the neck.

Such is the disposition of those parts of the bladder, which are fixed to the mass forming the perineum; we have seen that the remainder of the organ is moveable, and also the manner in which it changes its position, according as it is more or less distended with a fluid.

We remark two systems of muscles in the bladder; the one destined to retain the urine accumulated in that organ, and the other destined to compress that fluid, and to make it pass out by the urethra. Each of these two muscular systems is found either in the substance of the bladder itself, or on the outside of the organ. The muscular agents destined to retain the urine consist of circular fibres, sometimes not very evident, but more numerous the nearer we approach the neck of the organ. We perceive these circular fibres in the prostatic portion, but they are still more fully developed at the commencement of the membranous portion; their action is to contract the neck. This contraction is assisted sometimes, but rarely, by a small fasciculus of muscular fibres, which, arising from the two extremities of the prostate, pass above the neck of the organ, and by their action tend to draw the two lobes of the prostate together, and consequently to contract the opening of the neck. Lastly, the most powerful agent, destined, by its contraction, to retain

the urine in the bladder, is the anterior part of the levator ani muscle, the fibres of which being attached to the fibrous tissue covering the prostate, and being blended with those fibres which form the anterior part of the sphincter ani muscle, tend by their action to raise the fundus of the bladder; by which we mean, that part of the viscus which corresponds to the prostate, and to the anterior part of the anus, and consequently it causes the lower part of the neck to be compressed against the upper; this is, as we see, another favourable disposition by which the neck may be closed, and opposed to the passage of the urine.

The muscular agents destined to expel the urine, are the middle coat of the bladder, and its auxiliaries; namely: first, the diaphragm and the abdominal muscles, which, in their action, press down the mass of intestines upon and behind this organ, and diminish its cavity; secondly, the middle and posterior fibres of the levator ani muscle. These fibres are attached superiorly to the pelvic fascia, which line the sides of the pelvis, and are united below to the middle and posterior part of the sphincter ani muscle, so that they tend by their action to carry the posterior and inferior part of the bladder towards the neck, and thus give it an expulsive action. With regard to the muscular coat of the bladder, we know that it is composed of two layers of muscular fibres, placed one upon the other, arising from four fasciculi which pass from

around the neck, and form the acting part of the bladder; we know that these fibres are sometimes slender and numerous enough to form, when distended, a fine and delicate membrane, and are at other times disposed in fasciculi or bands, often so far apart as to constitute a kind of contractile network, by which the mucous membrane is irregularly supported; we know also that these bands or fleshy fasciculi, are often irregularly distributed in the coat which they form.

When the bladder of a dead subject is filled with as much water as it can contain, without being too much distended, it measures about three inches from the fore to the back part, that is to say, from the neck to the point exactly opposite; its width is nearly the same; its depth varies from three and a half to four and a half inches; its most sloping point will be found to correspond to the part which unites the anterior and middle third of its antero-posterior diameter.

Such are the documents which the surgeon lithotritist ascertains by examining the bladder on the dead subject. These documents are undoubtedly valuable, but if the surgeon reckons upon finding, in those patients he would submit to lithotrity, the form and the proportions we have just described in the viscus under consideration, he will find himself much deceived and much disappointed. The bladder of the living subject is not similar to the bladder of the dead subject; in

the latter it is inert, dilates easily, and is motionless; in the former it contracts powerfully, varies in its dimensions, and in its degree of contraction, according as we examine it comparatively in different individuals, or study it separately in one single person. Before we bring the bladder into contact with the instruments in such relations as will throw some light upon the laws which govern its contractility, let us develop some of its physiological functions.

The bladder is the reservoir of urine; this liquid gradually secreted in the kidnies, descends gradually into the bladder, fills it by degrees, until a particular sensation warns the individual of the necessity of voiding it. We know not how this sensation is produced. Does it result from the distention of the viscus?—No; for the desire to make water is frequently felt when the bladder is not distended. Does it result from the contact of the urine with an organ whose office is to produce this sensation?—This may be the case; but may it not be produced simply by the urine being in contact with the neck? This does not appear to us an unreasonable supposition, since it is generally in those parts where the mucous membranes are contracted, that the animal sensibility is placed. The sensation of a desire to void the urine is felt, and it is communicated to the extremity of the urethra, to that spot which we mentioned when speaking of the canal.

If the individual obeys this sensation as soon as he feels it, the function is performed slowly and with ease; the neck of the bladder opens, the contraction of the organ is moderate, and the urine flows with hardly any effort, in a full and continued stream, and without any irregularity; the abdominal muscles hardly assisting in the function.

If the individual resists the impulse, and wishes to retain his urine, the bladder fills still more; the desires to void his urine succeed each other rapidly: they cease, and are again felt; the bladder contracts with pain; the circular fibres of the neck, and the little muscle of the prostate are no longer sufficient to retain the urine, but it becomes necessary for the anterior fibres of the levator ani muscle to exert their action; and lastly, the individual assists this muscle, by placing his hand on the perineum in order to depress it, and to assist the contraction of the neck. He also leans forward to deprive the muscular coat of the bladder of its auxiliaries; he hardly breathes, in order that the chest, containing only a small quantity of air, may allow the diaphragm to become more concave, so that its attachments being brought nearer together may allow less purchase for its contraction. Lastly, the abdominal muscles being relaxed by the bending of the body forwards, no longer press the intestines upon this organ: it however soon rebels, contracts spasmodically, and taking upon itself

the performance of the act, it requires imperiously that the individual should yield to the impulse, and allow the urine to flow through those obstacles which result from the contraction of the neck and anterior part of the levator.

This is the external appearance of an individual under the influence of a violent desire to make water; let us now consider what takes place internally.

As long as there is only a slight desire to void the urine, the neck closes by means of its circular fibres alone, or perhaps by the small muscle of the prostate, when it exists. From an examination of the disposition of these fibres during their contraction, we should think that the muscular circle which is called the neck, becomes elongated, and projects within the cavity of the organ. If the desire to make water increases, the prostate and the anus are drawn up by the anterior fibres of the levator ani muscle, and the fore-part of the fundus is considerably altered by this contraction; its form is completely changed—it is more like a funnel, more raised, and becomes nearly level with the neck; the antero-posterior diameter of the bladder is diminished in direct proportion to the contraction of the sphincter of the bladder, and in proportion to the degree of elevation of the fundus by the anterior fibres of the levator ani muscle.

But if the desire to make water still increases, and the individual still wishes to retain it, then a

struggle arises between the muscular apparatus whose action is to expel the urine, and that whose action is to retain it. If, on the one side, the neck closes itself, if the anterior fibres of the levator ani, and the small muscle of the prostate, contract to prevent the urine passing out; on the other side, the muscular coat of the bladder comes into action, the abdominal muscles lend their assistance, and press down the intestines, which obeying the impulse given to them, glide along the inclined plane which the peritoneum covering the distended bladder presents to them, insinuate themselves between this viscus and the sacrum, accumulate in the space left between these two parts, and thus compress the bladder from behind forwards, and from above downwards. During the time that the bladder, thus acting by itself, is further assisted above by means of the abdominal parietes, it is equally assisted and contracted below by the action of the middle and posterior fibres of the levator ani, which raise the posterior part of the fundus to expel the urine, as its anterior fibres raise the anterior part to retain it; thus changing this part of the bladder into a funnel shape, which is elevated according to the contraction of the muscle.

From this struggle, in which we perceive an alternate action of each of the muscular apparatuses engaged, there results from necessity a change of form in the viscus, according as the

power of the expulsive apparatus predominates over the retentive, or vice versâ.

If the contraction of the bladder ceases, the fibres which compose its middle coat become less tense; if the abdominal muscles no longer act, the posterior and upper parts of the bladder enlarge; if the posterior fibres of the levator ani discontinue their action, the fundus of the bladder becomes more round and capacious; if the neck ceases to contract, it projects less into the bladder; and lastly, if the anterior fibres of the levator allow the prostate to be depressed, the antero-postero diameter increases.

When the muscles renew their action, either separately or collectively, the organ changes its form under the influence of each of these contractions, so that its parietes are, as it were, floating backwards and forwards. Hence it results, that during the operation of lithotrity the bladder presents two phenomena:—if the contractions are separate, it frequently changes its form; if the contractions are general, the whole size is diminished. We see how important it is for the surgeon to know all these phenomena, and to ascertain with rapidity when they commence, when they augment, and when they cease, since they may modify each of his manœuvres.

When the individual wishes to make water, after having resisted the desire for a long time, the urine does not flow immediately; the muscles which

retain it must recover from that state of spasm, which their long-continued contraction has produced; the expelling powers themselves must recover from their fatigue and resume that energy of which they have been deprived, by their long-continued efforts and contractions; and lastly, the sensibility of the organ must be aroused from that state of torpor into which it has fallen from the too powerful sensations it has experienced. Hence it happens that the stream does not flow immediately, the urine is at first expelled by jets, and frequently the bladder does not empty itself completely.

While the individual is thus under the influence of a desire to void his urine, there are two phenomena well worthy of remark :—the first is the intermittence of the contractions of the bladder, an intermittance which makes its expulsive efforts resemble those of the uterus; the second, is the great force with which the urine is expelled from the bladder. We shall return to the consideration of these two phenomena when we speak of the operation.

Now, on considering the resistance which the individual makes against the desire to void his urine, we find him in an exactly similar condition to that when undergoing the operation of lithotrity, and we have concluded that the bladder changes its form under the influence of these contracting powers; we have also been led to this

conclusion from the anatomical examination which allows us to infer what may be the nature of these changes; but as all that we have yet said is merely theoretical, since we cannot have the organ contracting before our eyes, let us see if we shall not find in practice some proof that our theory is not entirely devoid of foundation.

When we inject the bladder of a patient to such a degree that he feels a desire to make water, without this desire being violent, if we estimate the depth of the bladder with a *recto-curvilinear sound* (see this sound, Pl. 4. fig. 1. 2. 3.), which, on account of the manner in which it is curved is well adapted to this purpose, we shall perceive that, in the generality of cases, the bladder is not more than three inches deep, and three inches wide; and that it remains in the same state as long as we do not stimulate it by moving the sound. We feel distinctly that its fibres, although extended, do not project, and are not vibrating nor hard; that the sound moves easily backwards and forwards, that the fundus of the bladder is completely round and uniform, that the neck has the same form as on the dead subject, being in the centre of a perpendicular, circular surface; since the curvature of the sound being brought to this part, may be carried either upwards or laterally, and often even downwards, provided there be naturally sufficient depth beneath the neck in the bladder we are examining. If we stimulate the bladder with a sound, till

a desire to make water is produced, and this organ contracts, we easily perceive, by the difficulty we experience in moving the point of the instrument in every direction, as we did before, that the diameters are a little changed; and particularly that the point of the instrument, when it approaches the neck, cannot be directed downwards; for as soon as we incline it laterally, when it becomes level with the neck, it encounters the anterior part of the fundus: from this it is evident *that this part is elevated during the simple retentive contraction.*

We also perceive that the movement backwards and forwards is more limited, but that it is rendered easier, and can be carried to a greater extent the more we depress the handle of the sound, and the more we direct the point towards the concavity of the sacrum.

If we endeavour to ascertain at the expense of what part the antero-posterior diameter of the bladder is thus diminished, we shall find that it is at the expense of the anterior part which corresponds to the neck; for we see that the sound passes in quite as far as when there is no contraction, but that we cannot withdraw it as far out of the canal, when we bring its curvature towards the neck.

If we remark that this experiment is made before the desire to void the urine is very violent, and when it is only carried to a sufficient degree to make the patient feel the necessity of retaining it, we may conclude, *that whilst the desire to make*

water is moderate, which includes only a simple retentive contraction, the bladder diminishes in its antero-posterior diameter, at the expense of the anterior portion.

Now if after having injected water into the bladder, in so small a quantity that the patient feels no desire to void it, and after having examined the regularity of its form, and more especially its diameters, as we did in the preceding experiments, we throw in a sufficient quantity of water to cause an extreme desire to void it, we make the following observations, according as, first, *the patient wishes to retain his water;* and secondly, *according as he yields to the desire he feels, without assisting the expulsion with the influence of his will;* or thirdly and lastly, *according as he adds to the expulsive power of the bladder the influence of his will.*

If the patient wishes to retain his water, and does not contract the abdominal muscles and diaphragm, we perceive that the sound continues to be limited in its movements in the fore part of the bladder; we can withdraw it less out of the urethra, and it is impossible to bring it to a horizontal position, not only in the fore part close to the neck, but also in the whole extent of the fundus. This impossibility of turning the point of the instrument arises from the elevation of the fundus, and is consequently a proof *that during a strong desire to pass the water, caused by the injection of too large*

a quantity of this fluid (which supposes a retentive and an expulsive contraction existing at the same time) *the fundus is contracted and elevated in its whole extent.* But if, besides this contraction of the neck, and of the levator muscle, which causes the neck to project, and raises and contracts the fundus, the abdominal muscles and the diaphragm contract also; we shall perceive by directing the curvature of the sound towards the fundus of the organ, and placing the instrument in a horizontal position, that this curvature much sooner encounters the posterior part of the organ, whether we direct it towards the concavity of the sacrum, or towards that part of the bladder which corresponds to the union of its superior and posterior parts. This is a proof *that during the violent contraction of the bladder, caused by the injection of a large quantity of fluid, the posterior part, particularly its upper portion, advances towards the neck.* This is, as we already know, caused by the contraction of the abdominal muscles, and the diaphragm pressing down the intestines to this part.

From this it follows, that if during the violent contraction of the bladder, caused by the injection of a large quantity of water, the anterior part advances towards the sacrum, if the posterior part advances towards the neck, and if the fundus is contracted and raised, the bladder, *instead of being enlarged by the injection of a large quantity of water,* as would be the case were it an inert pouch,

diminishes in capacity towards the inferior portion. Now as it is precisely in this part that the operation of lithotrity is performed, we can readily conceive how important the knowledge of this fact is.

But we shall become better acquainted with this fact, if we continue to examine what takes place when the patient yields to the impulse to void the water when the bladder is thus distended, and when the water is allowed to flow out. If after having carefully ascertained the state of the bladder whilst the patient retains the water, we desire him to yield to the desire he feels, without however adding the influence of his will, we observe, that as soon as the water begins to flow out between the instrument and the canal, if we withdraw the sound towards the neck of the bladder, we find it comes out of the urethra to a much greater extent (nearly an inch), and also that the turning its point from right to left can be accomplished with much greater facility, but only near the neck.

If after a moment we direct the point of the instrument to the right and to the left, but more deeply, we remark that this inclination becomes easier, but the facility of turning it is only entirely regained when the desire to void the water is quite subdued. If we examine the fundus of the bladder we see that it is deeper, that it is more round, and more equal, which proves that *when*

the bladder is in a state of contraction, if we let some of the water which it contains flow out, it increases in size at its fundus. This is, as we see, in direct opposition to the generally received opinion.

Now, if instead of desiring the patient to let his water flow out without the influence of his will, we on the contrary enjoin him to expel it, we shall perceive that the neck allows the sound to pass out of the urethra to a greater extent, and that the fundus close to it is depressed, but that it remains elevated at that portion which corresponds to the posterior part of the sphincter ani and to the beginning of the rectum; we shall perceive also that the part of the bladder turned towards the concavity of the sacrum, especially at its upper part, advances towards the neck according as the abdominal muscles and diaphragm contract under the influence of the will. Hence it follows that the bladder assumes a different form when it empties itself under the influence of the will, or under that of its organic contractions.

Let it be understood that I am only speaking of the organ when it empties itself from the tenth to the seventh ounce, for from the sixth ounce its form continues the same whether the water is discharged by the one influence or the other; the bladder already begins to assume the form of the disk we mentioned, and the expulsion of the water is completed by the posterior fold of this disk approaching its pelvic or anterior portion.

It results from the facts I have just advanced, that the bladder, when we have injected a large quantity of water into its cavity, often contracts, and that when we diminish this quantity it increases in size. Now, as the contrary is the general opinion, it will be as well to give some explanation of this fact.

It appears extraordinary that the bladder although distended with water, can, without any of this water escaping, contract to such a degree, that the sound can only be moved from the extent of from an inch to an inch-and-a-half from the fore to the back part, and to about an equal extent laterally. As the water is incompressible, and the volume of the fluid in the organ remains the same, it must of necessity change its position during the state of contraction, and this is what in reality does take place; this water forced from the lower, flows towards the upper part of the bladder, or as I commonly express it, *the lower part of the bladder, by its contraction injects the upper*. Indeed, if we compare the muscular power of all that portion of the bladder, which is situated above a horizontal line drawn from the neck and passing round the viscus, to that which lies below this line, we shall readily conceive that when the organ contracts throughout its whole extent, one of these parts must yield to the other. In the upper part there is only the muscular coat, and even this is weaker at the apex than else-

where; whilst in the lower portion there exists, not only the muscular coat, which is itself very much developed, but also powerful auxiliaries; it is not, therefore, surprising that when these two halves of the organ are contending together, the weaker should yield to the stronger, and that that portion which presses least upon the liquid, should become distended notwithstanding its contraction.

If now we consider the great dilatation which may take place in the upper part of the bladder, as is proved by the large collection of fluid in some cases of retention of urine, we shall come to the important conclusion that *the bladder may receive a large quantity of fluid without being dilated at its lower part.*

When the bladder contracts forcibly, we perceive, by means of the sound, some secondary dispositions, depending entirely upon the muscular coat, and the most important of which I think it right to notice.

We sometimes, at the moment of contraction, have the sensation of hard extended cords, on which the point of the sound strikes and rebounds, and which give to the hand a shock sometimes so forcible as to deceive us, and induce us to conclude that we have touched a stone. We know that these vibrating cords are nothing more than columns which exist in certain bladders. If, with the end of the sound, we examine the part where

we experience this species of vibration, we find on each side of the fleshy pillar which produces it, a depression which is sometimes of considerable size, and into which the point of the sound passes; these depressions or cells are necessarily produced by the contraction of these *columnar bladders* upon the fluid they contain: the mucous membrane adhering closely to the kind of grating, which is formed by the fleshy bands composing its muscular coat, dips down where it is not supported, and projects where the muscular fibres are prominent. This, although a natural disposition, is one extremely important to be attended to in considering the operation of lithotrity; for when the muscular coat assumes this form in a very powerful manner, the simple depressions or cells become pouches in which the calculi may be lodged, and in which, moreover, the hooks of the forceps of an unskilful, careless, or unpractised operator may become entangled.

We occasionally perceive with the sound that some bladders do not preserve a regular form during their contraction, although perfectly regular when not contracting; the sound detects a space to the right or to the left, whilst the space on the opposite side is not so extensive. The contraction having ceased, this irregularity disappears. On examination, we find that the cause of this disposition arises from the difference in some bladders, with regard to the thickness and number of their

muscular fibres, which being unequally distributed in the organ, cause the greatest contraction in those parts where they are in the greatest number; we meet with this irregular distribution of the muscular fibres more particularly in those bladders in which the muscular coat is arranged in fasciculi, and this adds still more to the difficulties which this species of bladder presents to the lithotritist.

But if the surgeon who examines the bladder discovers its different contractions with the *recto-curvilinear sound*, he will more readily perceive them when, having introduced the lithotritic forceps, he tries to appreciate the different sensations he feels, and seeks to account for their causes. In fact when we operate with the three-branched forceps, which instrument I take for example because it is more generally known than my own instruments, we remark the following circumstances:—

The instrument being introduced and expanded in a bladder naturally capacious, in which we have injected a quantity of water sufficient to distend it, without causing its contraction, we find that it can be moved freely, that its branches, although projecting nearly two inches and a half from the tube, may be carried to the bottom of the organ, and may be brought to its neck in an extent of half an inch, so that we can easily seize any calculi which are in the fundus; the bladder accord-

ing to its degree of contractibility, allows the surgeon to seize the stones two, three or four times, and to submit them to be perforated or crushed by the action of the drill; but after these manœuvres, which, in subjects who are not irritable, are accomplished without our perceiving any great difference in the capacity of the bladder, we find that the instrument can no longer be brought so far towards the neck, that the stones are not so easily seized, and that generally they are in a more distant part of the organ. If the surgeon inquires into the cause of this, he will find it produced by the circular contraction of the neck, as well as by that of the anterior fibres of the levator muscle.

But after a short time the movements, which were only limited from the fore to the back part (which obliges us to shorten the branches of the forceps), become limited laterally; the instrument which could be carried to the right or to the left, is kept in a straight position; it is compressed, and, as it were, surrounded by the fundus of the bladder, which at last presses upon it to such a degree, that if the operator leaves the forceps to itself, he will see the handle elevated slowly and alternately, corresponding to the alternate movement of contraction, which, although permanent, experiences different degrees in its force.

If the surgeon continues his endeavours to move the instrument, it is still retained with the same

force; if, on the contrary, he remains quiet, the instrument presently becomes free, in the same regular manner in which it became fixed; it can first be moved laterally, and afterwards, anteriorly and posteriorly.

Should the surgeon, thinking that the instrument has thus become immoveable, because the bladder does not contain a sufficient quantity of water, inject an additional quantity through the forceps, the contraction and immobility of the instrument is increased, and lasts for a longer period.

Now, what can cause this immobility of the forceps if it be not the contraction of the fundus in its antero-posterior diameter, and also laterally?

If the surgeon is operating in a bladder which contains a number of fragments, and attempts to close his forceps during these contractions, he will find that it is frequently impossible to do so, notwithstanding the care he may take to raise the branches of his forceps in order to carry them from the fundus; he is often unable to close them without taking some fragments, which proves that the fundus is elevated during the contractions, since it brings these fragments within the instrument.

In some patients it happens, that the forceps, being expanded and drawn towards the neck of the bladder to seize the stones, cannot be carried back towards the posterior part of the organ,

but is retained near the neck. If we wish to push it back we are obliged to draw the branches together, without closing them completely; then the forceps passes to the posterior part of the bladder with facility. When the branches, drawn towards the neck, are thus held in this situation, the forceps is nearly motionless, and appears placed in a pouch anterior to the bladder itself.

We experience this sensation still more frequently when the forceps is charged with a small stone, or with a fragment, which by their small dimensions allow the branches to be brought near to one another; we perceive then, but only in some cases, that if we draw these branches towards the neck, whether inadvertently or in order to see if the instrument has free play in the interior of the bladder, we cannot carry it back again into the organ without difficulty; we perceive that the slight expansion of the forceps gives us the more readily this sensation of two cavities, one anterior, and the other posterior, separated from each other by a membranous septum, and this sensation is felt in bladders which, when not contracted, appear well formed. Now by what cause can this phenomenon be produced, if it be not by the contraction of the anterior fibres of the levator muscle, to which we have already directed the attention, and which raises all that portion of the bladder which corresponds to the prostate, and to the extremity of the anus? This

part of the organ forms behind the neck a cup, which in some measure lengthens the broad part of the funnel presented by the prostatic portion of the urethra, and also forms that species of cavity of which we are speaking, and which the surgeon ought to be acquainted with in order to avoid being entangled in it.*

Let us now return to the examination of the bladder on the dead subject, it will still give rise to some considerations of great importance, for we shall consider it in relation to a straight sound, a curved sound, and to stones of different dimensions and different shapes.

We remarked at the commencement of the examination we have made, that if a straight sound was introduced into the empty bladder of a dead subject, the point of this sound *would project in the centre of the disk which the organ forms behind the pubis;* now if through this straight sound we inject water into the bladder until it as nearly as possible resembles a sphere, we see that the sound traverses the organ from the fore to the back part, so that it may be considered as the axis of the

* Examine those large calculi which are composed of two lobes, one anterior, smaller, the other posterior, larger. The circular groove separating these two lobes is produced by the disposition we are here alluding to. Might we not almost venture to say, that nature moulded those calculi to prove the existence of the phenomenon in question ?

sphere; there is below the sound as much space as above it, and it is nearly at right angles with the neck and the surrounding parts.

If we wish to carry the extremity of the sound in different directions in the bladder, in order to ascertain what parts we can reach with facility; we find, first, that it is impossible to touch all that part which immediately surrounds the neck, that to reach that portion where the fundus begins to be horizontal, situated about an inch and a half below the neck, we must raise the handle of the sound considerably, to such a degree as to place it nearly perpendicularly, which must necessarily produce considerable depression of the organs.

If we do not wish to cause this depression, which would be too painful on the living subject, we then find that the point of the sound only attains with facility the horizontal part of the fundus, at about an inch, or an inch and a half from the point which unites this portion to that flat and perpendicular portion surrounding the neck. From this disposition it results, that the sound leaves between the part where its point touches, and the neck of the bladder, a considerable space in which stones may be lodged; this space is larger in proportion as the oval depression which we mentioned is more developed.

We find that between this point where the extremity of the sound reaches without difficulty, and the point where the posterior part of the blad-

der becomes perpendicular, it is easier to depress the sound to the fundus, the further the point we wish to reach is from the neck.

If we direct the sound to the right or to the left, the spot which we can reach laterally is much further from the neck than when we carry the instrument downwards. There are two ways of accounting for this; the first is, that the sides of the bladder are further from the opening of the neck than the inferior part of the organ is, and the second, that the thighs limit the movement of the instrument; from this it results that a space is left between that point to which the sound reaches laterally, and the neck of the bladder in which space calculi may conceal themselves.

If we direct the extremity of the sound towards the upper part of the organ, we find, that we can, by considerably drawing down the suspensory ligament of the penis, make it reach as high or even higher than the sacro lumbar symphysis; and if we imagine the fundus of the organ raised by the contraction of the levator, without the bladder being diminished in its diameter by the contraction of the abdominal muscles and diaphragm, we see that by directing the instrument towards the sacro lumbar symphysis, the forceps charged with a stone can find space and be free during the contractions. The knowledge of this disposition is of the greatest importance, for, as we are often obliged to relax our hold of the stones or frag-

ments, when the contractions continue for a length of time, we must not only know the parts where we can separate the branches of the forceps to accomplish this purpose, but must also know that part where it is impossible for the fundus of the bladder, by its elevation, to bring fragments between the open forceps. If, instead of introducing a simple straight sound into the bladder, we pass a three-branched instrument, and make the branches project about two inches and a half from the tube; if we place the longest and the shortest branches inferiorly and on a horizontal plane, depressing the extremities of these branches sufficiently for them to be in contact with the fundus, we shall perceive first: that the spot where the branches project from the external tube is in contact with the neck, and that the parietes of this neck project between the two expanded branches; secondly, that the hooks of these two branches, carried to the fundus, exactly comprise between them that portion of the bladder which the extremity of the straight sound reaches with facility; and thirdly, that when we raise the forceps thus expanded, till the tube becomes horizontal, the third branch of the instrument being carried upwards, approaches nearer that part of the bladder which corresponds to the sacro lumbar symphysis, the more this part is depressed by the intestines which we force down upon it, in order to imitate the effect of the contraction of the abdominal muscles and diaphragm.

We come to the conclusions then, that during the operation, we must, first: avoid pinching the neck, which might happen if care be not taken in manœuvring, and if the good construction of the instrument does not prevent it; secondly, that in common cases, if the stone lies at that spot where the extremity of a straight sound reaches, it will be easily taken between the two branches of the instrument placed in a horizontal direction; and thirdly, that during the contraction of the abdominal muscles and diaphragm, which by their action depress the upper and posterior parts of the bladder, the hooked extremity of the superior branch is in contact with that part of the organ, which is a reason why we should be doubly cautious. All these facts furnish an equal number of indications to the lithotritist.

Now, if instead of a straight instrument we introduce a curved sound into the bladder, we shall find that its point is directed upwards where the stones are not situated, and that it is removed from the fundus where they are generally found; this leads us to the natural conclusion, that lithotrity cannot be properly performed with instruments, presenting a curve in that portion of them which remains in the canal during the operation.*

---

* The exclusion of curved instruments is founded on the impossibility of bringing their extremity into contact with the fundus of the bladder where the stones are placed. But since the curved

In order to continue our examination, let us now place some stones in the bladder, and consider it in relation with these foreign bodies. If, after having laid open the bladder of a dead subject lying horizontally, so as to give the fundus a form similar to that it possesses, when it is distended with ten ounces of water, we examine which is the lowest part of the organ, we shall find that it is at nearly an inch and a quarter, or an inch and a half from a perpendicular line which would fall level with the neck.

If we let any round body drop into the fundus, for instance a common marble, (a child's plaything,) we shall see it roll down and lie exactly in the declivity we have pointed out. If we measure the distance from the neck to this marble, which we suppose to be six lines in diameter, we find that it is an inch and a half, deducting half the diameter of the marble, which makes it an inch and three lines.

If now we consider that this spot where the

---

portion, when it is small, can be depressed upon the stone by bringing this portion to a horizontal position, it follows that an instrument constructed on the principle of a small curvature may not only be found applicable, but may in many cases offer great advantages. That portion of the instrument, however, which, during the operation, remains in the canal, must be perfectly straight. This will be better understood after having read the *generalities* which precede the description of the instruments.

marble falls, is exactly that part of the bladder where the point of the straight sound reaches with facility, and also that which corresponds to the two expanded branches of the forceps enclosed in a straight tube, we shall conclude, that it is just at this spot that *the lithotritist ought to search for and to seize a small stone, for in this situation it will be found on account of its roundness.* We shall arrive at this conclusion the more readily if we bear in mind that the smaller the stone is, the further it is situated from the neck of the bladder, and consequently more exactly corresponds to that spot where the branches are most separated from each other.

Now, if instead of a marble of six lines in diameter, we put into the bladder one of twelve lines, we shall find that it will also roll to the lowest part, and that its distance from the neck will be an inch and a half, less the six lines, which is half its diameter, it will therefore be an inch from the neck, while the marble of six lines will be an inch and three lines; now, as we have come to the conclusion that the stone of six lines in diameter, was, with regard to its distance from the neck, at the exact spot where the two branches are most separated, we must also conclude that the stone of an inch in diameter, approaching nearer to the neck on account of its size, will not be so easily engaged between the expanded branches; for, if on the one hand, its approaching nearer to the neck makes

it correspond to a part where the branches are less expanded, on the other side, its increased size renders this want of space still more perceptible.

If now we place in the bladder a marble of from eighteen to twenty-four lines in diameter, the size at which the power of lithotrity ceases for round stones, and above which we ought to give up all hopes of destroying calculi of this shape by these means, we shall find, by proceeding in the same way as with the others, that the distance of this marble from the neck is only nine lines in the first case, and six in the second. If we endeavour to seize this voluminous marble of from eighteen to twenty-four lines, as we did the others between the two expanded branches, we shall find, that although it can be embraced by the branches at their widest point of expansion, it cannot, as it is placed in the bladder, enter between them; for, on account of its diameter, it is too near the neck, and nearly corresponds to the spot where the two branches reunite to enter into the tube which contains them. Two difficulties then prevent our accomplishing this purpose: the space to receive the marble diminishes in proportion as the marble increases, and in order to seize it with facility, exactly the contrary is required.

Let us bear in mind this disposition, for when we speak of the instruments, we shall see that in order to seize large and round stones, we must

employ a mechanism quite different from that which consists in engaging them between the two branches of the forceps expanded and depressed upon them, as we described in the three-branched instrument properly so called.

In thus employing bodies exactly round, we see pretty nearly what relations exist between the bladder, the stones, and the forceps destined to seize them, and we are now enabled to lay down these principles.

First. *That the more spherical a stone is, the more immediately it becomes placed before the neck of the bladder, and consequently, being in the axis of the instrument, is more easily seized.*

Secondly. *That the smaller a round stone is, the easier it is seized, since its small size keeps it at a distance from the neck, and consequently it is at the spot where the branches are most expanded.*

Do not let us forget, however, that we are examining these relations in the bladder of a dead, but healthy subject, which always presents an absolute capacity, that is to say, which does not alter from contraction; for we must not imagine that there is always the distance we have mentioned between the neck of the bladder and the stones: on the contrary, it is seldom the case. A stone of an inch in diameter is mostly found quite close to the neck, and consequently is seized with great difficulty, since the lowest point of the fundus is at an inch and a half. This arises not only from the

contractility of the organ, and from the diminution of its antero-posterior diameter, but also from the absolute size of the bladder diminishing in general, in proportion to the augmentation in the size of the stone, which depends upon the thickening of the coat of that organ. But let us continue our examination on the dead subject, for it is the only means we have of speaking to the eyesight: when we have seen what takes place in an inert bladder, we shall then be enabled to consider it under the influence of contractility.

We have examined the bladder as regards its relation with round stones, let us now consider what are its relations with flat ones.

If we let a flat stone of six or eight lines in diameter, fall into the organ, we shall perceive directly that this stone does not move as the spherical one did; that it remains in any part of the fundus in which we place it, and does not fall into that part where the organ has its greatest declivity, that spot where it would be most easily laid hold of by the forceps. We remark also, that even if we place it lengthwise, and resting against the sides of the bladder, it remains there almost as if fixed; if we place it in the same position below the neck it retains its place, and with difficulty rolls towards the lowest part of the organ.

If we place the pelvis of the subject in a perpendicular position, and lay the flat stone upon the neck, and then put the pelvis in the horizontal posi-

tion, so as to resemble a man lying on his back, we shall find that the stone quits the neck, but that it does not descend to the lowest part of the fundus, but remains at that part where the perpendicular portion of the anterior wall of the bladder joins the horizontal portion, which in lithotrity ought to be called the fundus. Now we know that it is difficult to reach this spot with the forceps, and we see that flat stones are generally lodged here, but we see also that if the stone is small, it can be reached by the *recto-curvilinear sound*, and that by the means it can be easily moved.

If instead of a flat stone of six lines, we put in one of eighteen or twenty-four lines, we find that it also is easily placed laterally either near the neck, or far back—we can make it lie lengthwise, resting against the sides of the bladder; if, however, having simply put the stone into the organ, we move the pelvis several times, resembling the alternate motion of a man lying down and getting up, we find that a flat stone of this size generally becomes situated in such a manner that its anterior edge is about eight or ten lines from the neck, and its posterior about six or eight from the most distant part of the bladder; if we endeavour to move it from this situation, we find some difficulty in doing so, on account of its lying upon its flat surface, and this difficulty is increased, the larger the stone is; when it extends two inches in

its long diameter, its extremities generally rest against the sides of the bladder, and this prevents its being moved.

If with the *recto-curvilinear sound* we endeavour to ascertain what will be the feeling given to us by a stone of this nature and thus situated, we shall find it will give us the sensation of a large, wide and fixed surface, extending from the neck to the fundus of the organ.

We, however, observe that the *recto-curvilinear sound* being carried to the most distant part of the stone, and its point brought under it, can in this manner be brought back under the stone even to its anterior part, and can raise that part of the stone near the neck of the bladder, but not so as to turn it over, which would be of the greatest importance, for it is the only means of removing it to a distance; this turning over of the stone is prevented, by the fundus on which it rests being too horizontal; for although it can be raised, it is not to a sufficient extent to allow of its being placed lengthwise, in which position it must be placed, before being turned.

If we attempt to turn those flat stones which are less than twenty-four lines in diameter, we find that the smaller the stone is, the more easily this is done; when, however, the diameter is less than twelve lines, it is performed less regularly, on account of the want of weight in the stone, and the greater relative capacity of the bladder, and consequently

the stone, although raised, is too moveable, and cannot be so readily directed by the sound.

In examining the relations between flat stones and the two expanded branches of the forceps, contained in a straight tube, we shall find that they are not so readily seized as the round ones. First, the flat stone, when small, does not roll to the lowest part of the bladder, and therefore is rarely situated in the axis of the instrument; and again, the flat stone, when larger, is not so well adapted to be received in the forceps as the round; it wants that kind of dome, which renders the round stone, although of a large size, much more easy to lay hold of by depressing the instrument upon it. We see that the branches of the forceps depressed upon the flat stone do not embrace it, and are only applied to its upper surface; we can, however, manage to seize it, by passing one of the branches under it, but to do this, we must press forcibly on the neck, and employ a manœuvring, impracticable on the living subject.

It results then, from what we have just said, that flat stones are not so easy to lay hold of with the forceps destined to seize them, *in the horizontal position*, as round ones.

First, Because they are not so easily found in the axis of the forceps, especially when they are small. Secondly, Because not falling to the lowest part of the bladder, they are more likely to remain in those situations which we have pointed out, as

being beyond the reach of the forceps. Thirdly and lastly, Because their flat form is not so favourable, for their being engaged between the expanded branches of the forceps depressed upon them.

These are the principal observations which arise from our examination of the relations which exist between the stones, the forceps, and the bladder; we have given them with some detail, in order that the mind may be accustomed to analyse all the varieties which the form of calculi produces in lithotrity.

But should it be remarked that stones are not always either completely round or absolutely flat, as those employed in these experiments, we reply, it is certainly true, but in order to express our ideas on the subject, it was necessary to take the two extremes, and to consider the stones either absolutely round, or absolutely flat, and afterwards to leave it to the discretion of the surgeon to estimate what influence stones of any intermediate form may have with regard to the bladder and to the forceps.

In fact, if we put out of the question the very irregular stones, the greater number we meet with are of a flattened oval shape, which combines the two forms we have mentioned, and which we were obliged to select for examples, in order to make ourselves understood. We shall, however, find, under the article *stone*, that there are

some calculi which are absolutely round or absolutely flat.

Let us now pass to a very important subject.

We have seen that the spot of the fundus, which is the lowest part of the bladder, has a great influence on the degree of facility with which we seize the stones, whatever may be their form; since this facility is in direct ratio with the space between the stone and the neck, let us see if this space, so important to the success of the operation, can be increased. If instead of placing the pelvis in the horizontal position, we raise it a few degrees only, and then examine what may be the influence on a marble placed in the bladder, we shall find that this marble is scarcely moved; the lowest spot of the bladder not being of a great extent, the body remains there, for at the posterior part of this lowest spot, the back part of the bladder becomes too suddenly perpendicular for the fundus to be much modified by so slight an elevation of the pelvis.

In order then to alter this spot, we must raise the pelvis still more, and it is only when this elevation has reached to such a point that the axis of the body makes an angle of from 40 to 45 degrees with the horizon, that we remark the increased facility with which we can seize the stone from the alteration in this spot.

The marble then rolls towards the posterior part of the bladder, for the inclination is now suf-

ficient to cause that part which corresponds to the centre of the sacrum, to become the lowest point of the organ.

If we now measure the distance between the neck and the centre of this lowest part, we find it two inches and a half, and consequently a marble of six lines rolls at two inches three lines; a marble of twelve lines rolls at two inches; and a marble of twenty-four lines rolls at an inch and a half. We find that a flat stone of small diameter becomes better placed, with regard to the forceps; that a flat stone of large diameter is easily turned over, since by moving the pelvis it is no longer situated in the fundus nearly horizontally, but that like the pelvis it makes with the horizon an angle of 45 degrees. It is only necessary then to make it turn over to an extent of 45 degrees, in order to place it lengthwise or perpendicularly, and this is easily accomplished with the sound.

We shall see in the sequel what great advantage the lithotritist can derive from this elevation of the pelvis to an angle of 45 degrees, when he wishes to seize stones of considerable size. We shall see that, in the horizontal position, he can only accomplish this by making the bladder yield to the force and violence of his manœuvres, while, in the position inclined to the degree we have mentioned, he can seize the stone without using the slightest force, which, I once more repeat, ought

never to be employed in any of the manœuvres in lithotrity. Lastly, if, when the pelvis is in the horizontal position, we put into the bladder some irregular fragments of stone, such as might be produced by the action of the instruments, we find that these fragments roll with more difficulty towards the lowest part of the bladder, and less readily become situated in the axis of the instrument, according as they are more irregular, and according as their irregularity approaches nearer to the flat form, or presents sharp projections; we see that they remain readily in those situations where the forceps cannot reach them, and that being displaced from the lowest part of the organ, they have no tendency to return to it.

If, whilst the fragments are thus scattered in the fundus of the bladder, we raise the pelvis to an angle of 45 degrees, we find that many of them fall to that part, which from this position becomes the lowest spot: but that many which are most irregular remain in those spots to which they have become slightly adherent by their asperities. If, under these circumstances, and whilst the pelvis is elevated to this angle of 45 degrees, we give a shock to it by raising the table on which it is lying a few inches from the ground, and letting it fall again, we shall find that all the fragments, however flat, and however irregular they may be, fall to that part of the bladder which has become the lowest, and they do so still more readily, if

at the same time we depress this portion with the *recto-curvilinear sound.*

If we now replace the pelvis in the horizontal position, all these fragments, by a movement from the back to the front part, become situated in that part of the bladder which is naturally the lowest, that is to say, that which results from the horizontal position, and which we know is the spot where the branches of the forceps contained in a straight tube are furthest separated. From what has been said, we may now lay down these important rules:

First, *That it is extremely advantageous to raise the pelvis to an angle of forty-five degrees, in order to seize a round stone of an inch in diameter with gentleness to the organ, but that it is absolutely necessary to do so, in order to seize one of from eighteen to twenty-four lines.*

Secondly, *That this elevation is necessary, in order to seize flat stones, in direct ratio to their size.*

Thirdly, *That in order to seize the fragments of a stone with ease, this elevation is very serviceable for collecting them in that part of the organ most distant from the neck, and that it is often necessary to add to these means, shocks given to the pelvis, in order to become master of the most irregular of these fragments with facility.*

Fourthly, *To seize a stone less than an inch in diameter, the elevation of the pelvis is unnecessary, and may be disadvantageous, since in the horizontal*

position a stone of this size is naturally in relation with the two expanded branches contained in a straight tube.

To give, in the last place, some further idea of the advantages of the elevation of the pelvis to 45 degrees, we may remark, that during this elevation the intestines no longer press their weight upon the upper and back part of the bladder; this induces us to employ these means in order to diminish or put a stop to the too violent contractions of the organ, since this position deprives, or at least lessens, the influence of one of the most powerful auxiliaries which add to its contraction.

In the disposal of our means, as far as regards the position of the patient, it will be seen how we perform all the indications which are only suggested by common sense.

Such are the dispositions connected with the urinary organs, the knowledge of which may lead us to a successful application of mechanical power to destroy vesical calculi. When well studied, and well understood, the intention and nature of our labours will be more exactly appreciated.

ON CALCULI.

When calculous patients were treated by lithotomy, it was customary to conceal from them the disease with which they were attacked; if the surgeon found a stone in a healthy subject, who suffered but little, he avoided telling him, and awaited till his suffering, becoming extreme, obliged him to make the melancholy communication. But now, that we are acquainted with the art of lithotrity, the simplicity of which is the greater the earlier it is performed, it must be evident, that it is not only advantageous that the patient should be early acquainted with the nature of his complaint, but also in order that lithotrity may afford all the advantages possible to mankind, it would be of great service if the first symptoms of stone were so well known, that a patient could not remain long in a deceitful state of security with all the inconveniences which this disease produces at its commencement.

It is then with the express intention of making the knowledge of these symptoms more general, that I give a rapid sketch of their nature before I proceed to the consideration of vesical calculi. This sketch will be more carefully deduced from the causes which produce the symptoms, and arranged more methodically than has hitherto been done; so that by this means it will be rendered more easy to detect them, and consequently I shall arrive with more certainty at the end I wish to accomplish.

An Account of the first Symptoms of Calculus.

When, from some circumstance or other, there is a foreign body lodged in the bladder, and it remains there a short time, the salts contained in the urine are deposited around it, covering it more or less rapidly, and thus forming those concretions which vary in size, and are named vesical calculi.

It is necessary then, for the formation of these stones, that there should be some substance in the bladder around which these salts may be deposited.

Now, these bodies are found in the bladder, either from being introduced through the urethra, or from having penetrated through its parietes, or they may have been formed in its interior, or, lastly, they may have been formed in the kid-

nies, and may have descended into the bladder through the ureter.

Thus there have been found to form the nuclei of stones, peas, beans, the end of tobacco-pipes, pieces of sounds, pins, the teeth of combs, &c. &c., which had been introduced through the urethra. Some have been found having for their centre, shots, and even bullets, which have entered the cavity of the organ through its parietes;* others are formed at first by layers of lithic matter (λιθος, *stone*), deposited round a clot of blood, a little fibrin, or a collection of mucus secreted from the lining membrane; others have occasionally for nuclei other stones, extremely

* There is another manner, in which foreign bodies, by piercing the tissues, fall into the bladder. I am here alluding to certain substances which, having been swallowed, penetrate through the parietes of the intestines, and traverse the tissues in every direction, till they come to the skin, through which they pass out, or meet with some hollow organ, into which they fall.

M. Civiale has emitted, on this subject, a singular opinion: he thinks that these substances change their place, and pass from the stomach to the bladder, by following the circulation.

This gentleman having printed the ingenious supposition to which this phenomenon gave rise, I cannot do better than quote it from his work:

"Les mémoires de la Société d'Edinbourg contiennent des exemples dans lesquels des aiguilles avalées auroient été trouvées dans le vessie. Au rapport de Pouteau, des haricots blancs auraient aussi passé de l'estomac dans la poche urinaire, &c. *Si les faits rapportés sont exacts, ces corps suivent-ils le torrent de la circula-*

small, commonly known by the name of gravel, which, formed in the kidnies, have descended through the ureters into the bladder, where they have given rise to the formation of larger calculi; for their size prevents their being expelled through the urethra as soon as they fall into the cavity of the organ.

Of all vesical calculi, those which have gravel for their base are by far the most numerous, since out of twenty stones there will probably be nineteen with gravel in their centre. We must, therefore, particularly study the sensations which accompany this most frequent mode of the formation of calculi, and, in order to know these sensations, we shall examine the symptoms produced by the gravel in its formation in the kidnies, in its descent from the kidnies to the blad-

---

tion?"*—(Nouvelles Considérations sur les Rétentions d'Urine, 1823, page 115.)

It is very evident that French beans which have been swallowed cannot fall into the bladder by piercing the tissues, as needles or pins might do; if beans have been found in that organ they must have been introduced through the urethra, with intentions which the patient seldom owns.

---

* "The memoirs of the Society of Edinburgh give instances of swallowed needles having been discovered in the bladder; according to the statements of Pouteau, French beans must also have passed from the stomach to the urinary organ, &c. *If the facts related are correct, do not these bodies follow the course of the circulation?*—(Nouvelles Considérations sur les Rétentions d'Urine, page 115, 1823.)

der, by its remaining in the bladder, and by enlarging in this organ; so that, in this manner, we shall have the precursory symptoms of the stone, and the first symptoms of the presence of this foreign body in the bladder.

Medical science has not yet resolved the important question of what can cause this particular disposition, the effect of which is to separate from the urine that red or white powder found in the water of some individuals, which is deposited at the bottom of the vessel, sometimes in the shape of small round or sharp grains, and, at other times, in the form of extremely fine powder. But if medicine has not yet discovered the chemical process which Nature uses in the formation of this gravel, dissection has taught us that the kidnies are the part where it is formed—that from the kidnies it descends into the bladder through the narrow canal which conveys the urine from these bodies—and from that organ, finally, it is expelled with the urine. Such is the situation in which the gravel is formed, and such is its passage.

It may readily be conceived that, when this gravel is in a state of powder, it may pass through this route without the patient suffering much; and thus, we see many persons void this powder without its passage giving them the least pain.

But if, instead of being thus fine, the gravel traverses these passages in a gritty state, it then

causes great pain, and this is proportionate to the size of the gravel, the nature of which changes according as it remains in the kidnies, in the different parts of the ureters, in the bladder, or in the urethra.

When the gravel is in one of the kidnies, the patient has the feeling of being fatigued; he experiences a numb deep-seated pain, sometimes *shooting along one side of the spine just below the ribs;* this pain extends to the upper part of the hip, it ceases, and again is apparent upon some excess of diet; it is sometimes accompanied with fever, with a sensation of fulness, of heat and throbbing, a sensation which is deep seated. Occasionally, but very rarely, there are calculi in the kidnies without any of these symptoms.

When the gravel is lodged in the upper part of the ureter, just as it begins to distend this passage, the pains become more severe, they are more acute, and last longer; according as the gravel descends, they are felt lower and lower; they extend all along the side; when the gravel reaches the middle of the ureter, the pain is most severe, which the patient describes as shooting deep down to one or other groin, and often along the whole inner side of the thigh. Sometimes gravel of considerable size passes through the urethra without the patient having these acute sensations; but at other times it is accompanied with most excruciating pain, vomiting, hiccoughing, febrile symptoms, and, lastly, colicky

pains, known by the name of nephritic (νεφρος, the kidney).

The gravel remaining in the kidney, or ureter, sometimes gives a peculiar character to the urine; commonly during the violent pains it is white, and often very abundant, slightly mucous, sometimes puriform, and, lastly, at other times it is voided tinged with blood.

When the gravel reaches the bladder, the moment when it escapes from the ureter, there is occasionally a sensation of laceration, or that of a body falling into the organ; sometimes hemorrhage takes place to some extent, from the laceration of the edges of the extremity of the ureter which opens into the bladder; the patient feels himself instantly relieved from all the pain which was caused by the gravel when in the ureter, and if it be sufficiently small to pass through the urethra with facility, it often happens that it is carried along with the stream of urine when this fluid is expelled, and he feels no more pain; but if the gravel be large, or if, although small, the neck of the bladder rebels upon its approach, and by its contraction prevents its passing, then the gravel increases to calculi, or, what is not uncommon, there are calculi and gravel at the same time in the organ; other symptoms now arise, caused by the presence of gravel, which, as it cannot be expelled, is now called stone.

As soon as there is a stone in the bladder, the

first symptom it produces is that of derangement in the expulsion of urine; obeying the laws of gravity it continually falls towards the lowest part of the bladder, and as the neck becomes, from its perpendicular position, this lowest part, it follows that when the patient makes water whilst standing up, the stream will suddenly stop, will again flow, and again stop, until the bladder is emptied. The alternate presence of the stone will explain the reason of this interruption, its resting upon the neck without entering, stops this opening more or less completely, according to its position. Thus the first symptom indicative of a stone in the bladder, is *the more or less complete interruption in the stream of urine during its expulsion*, which arises entirely from a mechanical cause.

But the gravel, by its continued presence in the bladder, gives rise to a peculiar sensation, which we are now going to describe.

We know that when the bladder contains urine, the gravel must have free motion, and must obey the impulse given to it in the different movements of the body; now this moving is perceived by the patient, but not generally felt in the cavity of the organ where it takes place. The calculus when small, obeying the laws of gravity, always falls to the lowest part of the organ, but as on the other hand, it is as it were suspended in the urine, which has always a sufficient degree of density, it follows that whilst the patient is

walking, that little body is always moving, and that it continually rolls and bounds about in the organ, alternately striking against the neck with a degree of force proportionate to the shock given to the whole body: this shock, experienced by the neck of the bladder, is sometimes felt in the anus, but more commonly along the whole canal, and particularly at the extremity of the penis—the part where the patient feels, especially if he makes a false step, a sudden shooting sensation, which sometimes is only a momentary tickling, but at other times amounts to an acute burning sensation.

This peculiar sensation at the end of the penis, at first remains only for a moment, but afterwards becomes more permanent; whether it is that the bladder being emptied, allows the calculus to remain in contact with the neck which it stimulates, or whether it is that the stone becomes heavier, and does not so readily quit this part of the organ, the constantly-aroused sensibility of which gives the patient a continual desire to void his water, although the bladder contains but little fluid.

Thus the second symptom indicative of the presence of stone in the bladder, *consists in a sensation of tingling or shooting at the extremity of the penis, which is not permanent, but exists at intervals both during and between the periods of making water.*

These are the two first symptoms which occur

in the greater number of cases at the commencement of stone: *the patient ought then to take the advice given him, and undergo the operation of lithotrity,* which would then always be followed with success, *for the stone being still small may be destroyed in a few seconds, and the bladder being still healthy, allows the instruments to be expanded in it, which process, when well performed, ought never to cause any pain.*

From the moment there is a stone in the bladder, it continues to increase by successive layers of the salts, which are always held in suspension in the urine; sometimes it rapidly acquires a considerable size, at other times it only enlarges slowly: this difference arises from the nature of the salts of which it is composed, and the peculiar disposition of the patient. When there are several stones, they do not in general become so large: this arises from their being in contact, and rolling one against another, which impedes the deposition of the lithic layers.

But if, on the one hand, the stone increases, the organ which contains it soon becomes diseased, and then arise a train of symptoms, which become more and more severe, and which, according as they proceed, render the chances of the patient being cured by these means more doubtful.

Walking soon becomes painful, the desire to void the urine is very frequent, it becomes more and more acute, and so imperative that it must be

complied with immediately. The patient feels himself obliged to obey; the urine does not flow; the desire still continues; a little escapes; it again stops; a state of anxiety arises; the pain is more acute; it is again allayed; the patient again attempts, and by degrees at last succeeds in nearly emptying his bladder, and thus purchases a momentary calm, by painful efforts which will soon again be required.

It is in this alternate state of calm and suffering that the calculous patient lives, continually striving against the obstacle which opposes the flow of his urine; he is in constant apprehension from the suffering he has already had, and which he knows will not fail to return; his disease is, by its nature, always increasing and never diminishing; he has not the consolation of another patient, for he cannot like him hope for a spontaneous cure.

But if the anxiety of the patient increases under the influence of the pain he feels, it increases still more from the attacks the organ containing the stone suffers, and those which are injuring his constitution.

The bladder, which was at first healthy, dilatable, and not very irritable, gradually, and day by day, loses this desirable state; the internal membrane becomes irritated; it inflames, and secretes mucus at first similar to the white of egg, but which becomes more yellow, of greater consistency, and loaded with a puriform matter; the

sensibility of the organ is increased; it rebels against the presence of urine, which being frequently passed without the desire of the patient, leaves the organ nearly empty, to which at last it becomes habituated. Its parietes are then in constant contact with the stone, the sensibility still increases, and at last the organ is altered in its tissues, which become thickened, and its veins varicose, the glands connected with it enlarged and tumefied, and the lining membrane soft fungous, hemorrhagic, and sensitive. From this it results, that the patient who has neglected having the stone broken down when he was in a fit state, finds his sole refuge in lithotomy, the bladder being contracted, and the stone increased in size—two circumstances which prevent his cure by lithotrity.

The pains at last become so acute, and unremitting in the organs composing the urinary system, that other organs soon become affected: the skin assumes a yellow, earthy tint, a slow fever attacks the patient, a urinary smell exhales from him, digestion is impaired, and the general sensibility is increased, his breathing becomes affected, and the unhappy sufferer falls a prey to the most excruciating sufferings, vainly calling to his relief lithotomy, which he has rejected till it is too late to perform it without the risk of his expiring during the operation.

Thus terminates the existence of the man at-

tacked with stone, who, yielding to a foolish fear, allows the disease to increase, when it would be so easy to cure it at its commencement, by means which are as simple as they are devoid of pain and danger.

Such are the primitive symptoms of stone, and such are the consequences of the disease, when neglected. May the rapid picture I have just drawn, give those who are suffering under it a salutary warning against its fatal termination!

Now that we are acquainted with the manner in which calculi are formed, and know the symptoms they produce when they first exist, let us study them in their relations with lithotrity.

THE
SUBSEQUENT SYMPTOMS
AND
THE PHYSICAL PROPERTIES
OF
CALCULI.

SUCH, then, is a general description of the first symptoms of stone. Their exposition will lead us to many considerations on the difference which some of their physical properties cause in the nature of these symptoms. Since a knowledge of these physical conditions is very useful to the surgeon lithotrotist, it will be of service to describe the symptoms which they cause.

Small calculi passing from the kidnies to the bladder, are, as we know, composed of different salts: but among these salts there are two so predominant, that they form alone nearly nine-tenths of the gravel. These salts, which are the uric acid, and the mixed phosphates, are those to which we shall now direct our attention.*

---

* I must here make an important remark, and without which I should not be thoroughly understood. Although I make use of two chemical terms to distinguish the gravel, I have no intention to take notice of their chemical composition. I select the gravel of uric

The symptoms produced by gravel composed of uric acid, and those resulting from gravel of the mixed phosphates, present some differences worthy of remark.

When they are similar in shape, and of the size of from three to six or eight lines in diameter, (a size at which we may still consider them as simple gravel,) these two species do not produce the same effect in the organ, the sensibility and contractility of which re-act differently under different impressions.

The smooth and hard uric acid gravel moves

---

acid, and the mixed phosphates, for examples, only because the physical properties I am speaking of, are developed in a greater degree in gravel composed of these two salts: the gravel of uric acid is smooth and dry, that of the mixed phosphates is heavy, spongy, and presents those little sharp crystals, which render it so adhering, and so liable to be retained in the neck of the bladder when it is once surrounded by it. These are the physical properties generally characteristic of gravel composed of these two salts; but gravel of uric acid may be spongy and crumbling, especially when it is not quite pure; and gravel of the mixed phosphates may also be polished, and not spongy, if, in the same manner, it is not quite pure: for example, gravel of lithate of ammonia sometimes presents this character of sharp irregularities, which render it so injurious to the bladder; the oxalate of lime also presents these points, which are sometimes very sharp, but not so distressing; the proof is, that gravel of oxalate of lime seldom produces such severe symptoms as are caused by the triple phosphates with their sharp needle-like projections. Thus all gravel that is spongy, crumbling, and rough, will be distressing to the organ, whilst the smooth and dry gravel will be much less so. This is sufficiently pointed out in my work, which renders it unnecessary for me to say anything further upon the subject.

freely in the bladder, it falls into the neck, which it instantly blocks up during the expulsion of the urine: but being moveable and rolling about, it seldom remains in this position; it either bounds away, to return instantly, or its surface, which is most commonly polished, allows it, when placed in the funnel of the neck, to be forced out by the contraction of this part, which thus expels it by giving it a sliding movement; in this case, the irregularity which is caused in the stream of urine, is generally only instantaneous: for as it is often forced away, and again returns, the patient feels the attacks more frequently, but they are most commonly only of short duration. The uric acid gravel, which is dry, and of a density, but little greater than the fluid which surrounds it, rebounds about the neck, against which it strikes, either in the motions of the whole body, or during the expulsion of the urine; whence it is that the sensation of tickling or pinching at the end of the penis is generally felt by those patients who have red gravel of uric acid in their bladder, that this sensation is more severe, more sudden, and unexpected, and also that the stream of water is more frequently interrupted, but only for a short time.

Gravel composed of mixed phosphates is generally impregnated with the fluid which contains it; it is softer, and heavier, and is most commonly round; its surface is rough and uneven, and its

physical properties, so different from those of uric acid gravel, considerably influence the symptoms which it produces.

Loaded with moisture, and consequently of great density, it moves less in the organ, it rolls more slowly; any shock given to the body is not so readily communicated to it as to a smooth lighter gravel; it alters its position with greater difficulty, and when it does alter it, it remains for a longer time in that particular situation in which any motion of the body may have placed it, or to which it has been forced by the action of making water.

As long as this species of gravel is not at the neck of the bladder, the patient suffers less; but, unfortunately, it is generally at this spot with which it is in more direct and permanent contact. Whilst the patient is walking, it falls heavily down upon this opening, and thus causes a longer continuance of the painful sensation, and this sensation is more dull and heavy.

But if the mixed phosphate gravel produces such distressing symptoms when influenced by the motions of the body, they become still more painful during the time of expelling the urine; and it is at this moment that the form and nature of the gravel can be ascertained by the symptoms which arise from its physical properties. Most commonly, the stream of urine is not stopped very frequently. If the form and specific weight of

this gravel do not allow it to yield to the influence of the urine as readily as the uric acid gravel, and prevent it from passing so quickly to the neck, these physical properties cause it to remain, when once forced into that infundibulum which the neck forms during the act of expelling the urine; it does not readily escape from it; its chalky and uneven surface prevents the circular contraction of this part of the organ from forcing it out; it is locked in, as it were, between the parietes of the neck, and is held there the more firmly in proportion to the power of the contraction.

At first, the neck of the bladder does not feel its presence so acutely; it only surrounds and compresses it by its natural contraction, but this soon changes into a morbid action. The neck rebels against so disagreeable a companion; its sensibility increases, the membrane inflames, and then result spasms, a constant desire to make water, catarrh of the bladder, purulent urine, and, in a word, a collection of symptoms so severe, that one is quite astonished to meet with them in some patients who have only been afflicted with stone for a short time. We far less frequently meet with these symptoms when the bladder only contains uric acid gravel, which is rough; and we never observe them when the gravel is smooth and polished.

It will be seen that the different symptoms we have just described are caused by the external sur-

face and density of the gravel; but there are others which depend more especially upon the round or flat shape. This is particularly the case as regards the uric acid gravel; for those formed of the mixed phosphates are generally spherical, either regularly or irregularly, and it is seldom that they assume a flat shape. Let us, therefore, consider the uric acid gravel, since it is that which generally presents the forms we have mentioned; and let us apply what is said with regard to it, to gravel composed of other salts, whether they be flat or round.

Now, when there is flat or round gravel in the bladder, the symptoms of each are different, and it is of considerable importance to be acquainted with the difference; for it will serve to point out to us whether the stone in the bladder is flat or spherical—a circumstance of great importance, as regards our ultimate considerations.

When both the one and the other are very small, as soon as they fall into the bladder they enter into the neck, through which they sometimes pass, but where they more commonly remain, notwithstanding their small size; for there is such a degree of sensibility in the necks of certain bladders, that they contract the moment they are touched by the gravel.

It results from this contact with the neck, that there is at first a stoppage in the stream of water, which, in some cases, arises from the gravel coming

to that part of the organ without remaining there; in others, from the neck contracting spasmodically, when stimulated by the stone, to the contact of which it is not accustomed. Most commonly, when the gravel first falls into the bladder, these two causes combine together to produce more or less stoppage in the stream of water; for if it was not for this action of the neck, which, by contracting, prevents the gravel from passing, we should seldom find these small calculi remaining in the bladder; for their size would almost always allow them to be carried along by the stream of urine through the neck, which would have its orifice open ready to receive them.

When the gravel has been some time in the organ, the neck becomes accustomed to its presence, and the stoppage in the stream of water is no longer caused by the spasmodic contraction; it now arises from the mechanical obstruction of the gravel, which is increased in size.

In fact, it enlarges in a very short time to such a size, as no longer to take advantage of the neck not contracting, and it is now only its augmentation which causes it to remain in the bladder.

But if it increases in size, it generally does so according to its primitive form. If it was round when it fell into the bladder, it generally enlarges like a ball; if flat, it becomes enlarged in the shape of a bean.

The phenomena then produced as regards the stoppage of the urine are, as we before stated, very different.

Round gravel of four or six lines readily passes to the neck, for it yields to the smallest impulse of the urine, and coming to this opening, either remains in for an instant, or is arrested in the funnel which it presents. In the first case, the stream is impeded for a moment, and then again returns; if, on the contrary, the gravel remains in the infundibulum, the stream suddenly stops; and this takes place the more completely, and lasts for a longer time, the more round and less polished the gravel is.

The flat gravel, when it has acquired some size, does not cause the same phenomena. On account of its form, it does not so readily pass to the neck; and when there, it either produces no effect, or only very slightly impedes the stream.

If it produces no effect, it is because when lying flat it offers little resistance to the stream of urine, and yielding but little to the different movements of the parietes of the bladder on which it rests, it only approaches towards the neck; for the flow of urine does not continue sufficiently long, and has not sufficient power, to carry it against the opening.

If it only produces an irregularity in the stream, it is because its position, before the evacuation of the water, allows a considerable quantity of this

fluid to carry it quite to the neck, against the opening of which it rests, though its form is such that it does not completely close it.

Sometimes, but still more rarely, it lies flat upon it, and like a valve; it is raised according as the urine flows, but interrupts the stream, and renders it intermitting.

Sometimes also—and this is most commonly the case—it lies lengthwise, and allows the urine to pass along its side, and thus to be irregularly cylindrical; the stream is then twisted, and more or less regular, according to the impulse it receives from this cause.

Here, then, are two series of symptoms, by which we may judge *à priori*, and without sounding the patient, if the gravel he has had in his bladder, and which has formed the nucleus of the calculus, assumed a round or flat form, and we shall find that the possibility of deciding on this subject is of considerable importance.

Gravel descended into the bladder produces, in a greater or less degree, the symptoms we have just pointed out, which usually continue from the moment it falls into the bladder until it has attained such a size that it no longer bears any proportion to the opening of the neck, which consequently prevents its passing into this opening, and thus producing the results we have mentioned. Having acquired such a size, calculi continue to increase more or less rapidly, according as

different circumstances may modify the laws by which this increase takes place, and they are modified in their form, and even in their composition.

They may be modified in their form by the motion communicated to them by the body; for the more moveable they are in the bladder, they will be the more disposed, independently of all other causes, to assume a spherical shape; on the contrary, the more quiet a patient is, the flatter the stone will be, especially if the nucleus on which its layers are deposited had originally this form.

The circumstance of there being several calculi in the bladder also modifies their form in direct ratio of their size and number; for this modification depends upon the number of their points of contact; consequently, the more numerous they are, the more apparent is the modification. Thus two calculi in the bladder have little effect upon each other, if there is sufficient space for them to change their points of contact; but when they are of such a size as to be constantly in contact, they are worn away at one spot; so that the more the points of contact are numerous, the more they will be worn away, and they will be more worn away in proportion to the continuance of the contact.

The circumstance of there being many stones in the bladder modifies also their physical properties, in-as-much as it generally renders them polished,

It is under the influence of these different causes which we have just pointed out, that cal-

---

to derive its origin differently to other salts,* which most commonly alternate when there is time allowed for the stone to increase.

Secondly.—In general, when the calculi have become large, and when they are in contact with the parietes of the bladder, they become immoveable; now it is at this very time that the mixed phosphates are deposited upon them in a shapeless mass, and it is also just at this time that the bladder is inflamed, and its lining membrane diseased. In fact, if we remark all large stones, we shall find a great many of them covered with the fusible calculus. Now, why does this kind of concretion almost always terminate the formation of the stone in the bladder? If it be not bat the bladder inflames from its prolonged presence.

Thirdly.—These phosphates are seldom deposited in intermediate layers in those stones which they form;† they either commence the stone by constituting the nucleus, or they finish it, by covering it with those irregular products. What is the reason of this? Do not these two peculiarities indicate; first, that the formation of the

---

* Gravel of lithic acid is often covered by the same salt, so that a calculus is entirely composed of it; but this arises from its extreme predominance in healthy urine. This salt, however, alternates very frequently, since Dr. Yelloly's table proves that in 271 cases of lithic acid gravel, pure lithic acid was deposited only 164 times, and the other salts 107; and that in 274 cases of gravel of lithate of ammonia, the same salt of lithate of ammonia was only deposited 55 times, and the other salts 219 times. Now the cause of this preponderance cannot be found in the phosphates which are in small quantity in healthy urine, and if it is not dependent upon the secretion of urine, from whence does it proceed?

† In Dr. Yelloly's table there are 141 calculi, into the formation of which the mixed phosphates enter, but of these calculi there are 92 which cannot afford proofs of what we have advanced, for not being composed of more than one or two different layers, they could not be deposited intermediately; but in the remaining 49 in the composition of which there are three or four different salts, twice only are the mixed paosphates intermediate.

culi, as they enlarge, assume different forms in the bladder; but in enlarging they afford symptoms

nucleus is caused by a particular state, which I have termed *fluxionnaire* of the membrane; and secondly, that it is to a state of inflammation consequent upon the presence of the stone, that the formation of these phosphates is due.*

Fourthly.—If any foreign body enters into the bladder, and by its presence produces inflammation, the deposit which is formed around it, is almost always of mixed phosphates; we remark this more particularly when the bladder is in a state of inflammation previous to the introduction of such a body; look at the flexible catheters which are introduced and left in—in those cases where there is some obstruction to the passage of the urine, which almost always coexists with some inflammatory disorder, they become encrusted with the mixed phosphates. Now why should it be with these, and not with any other salts?

Fifthly.—What is the process which nature adopts in the formation of solid structures, such as the bones, the callous in fractures, those calcareous cases formed by the pleuracostalis around the lungs, the solid tubes in the arteries, the tubercular masses in the lungs and messentery, the false membranes in croup, the confluent

* This opinion of a catarrhal or fluxionary state pre-existing, and being the cause of the formation of the phosphates, may appear too speculative; but I think the following is a proof that there is some foundation for it. Dr. Yelloly's table proves that of 663 calculi, which he has examined, there are 143 into the composition of which the mixed phosphates enter. That of these 143, there are 35 composed entirely of this salt; 4 the nuclei of which are formed by this salt; 106 in which this salt forms the last layer or deposit, and 2 where it is intermediate. Now why does this salt continue to be deposited when it has once begun, if it be not from a particular state? and why seek for another explanation of the nature of this state, when there are 106 proofs that the mixed phosphates are the products of inflammation, since they are only deposited upon the surface of the stone, when it has caused inflammation of the bladder?

analogous to those we have enumerated, but which are modified by their physical properties, and especially by their form.

---

apthæ, those salivary and intestinal concretions found in man and animals? Nature deposits salts in those parts where she wishes to form these solid deposits, and what are these salts? Earthy phosphates; and what secrete these phosphates? Membranes, and most commonly inflamed membranes. Now if these membranes in general deposit these phosphates, why should not the genito-urinary mucus membrane do the same also?

When this deposition is evident between the prepuce and glands, why should we not conclude that it is present throughout the remainder of the same membrane?

If the gastro-intestinal membrane secretes these phosphates to form those calculi we meet with there, why may not the genito-urinary mucus membrane secrete them also? And if there be such a possibility, this theory is worthy of attention, and may lead to important conclusions; among which, I think, I may class this as of the first consequence, *that in cases of stone, and especially of those formed of mixed phosphates, the medical treatment should consist, not only in modifying the chemical nature of the salts, but also in changing the action of the membrane;* for we shall by our chemical agents no more prevent the genito-urinary mucus membrane depositing the mixed phosphates, than we shall by the same means prevent the formation of a callous.*

I conclude with this observation, that the mixed phosphates crystallize less regularly, and are deposited in less regular layers, the more inflamed the mucus membrane has been; when the kidnies, ureters, and the bladder are in a healthy state, the calculi composed of this salt are deposited in layers, and are even sometimes quite polished; but in cases of inflammatory disorders these depositions are very irregular.*

---

* When we find in a collection of calculi, those shapeless stones of the mixed phosphates, we may at once conclude that the patients, who had them, suffered excessively, and most probably were not cured.

When they are small, such as we just now considered them, they roll and move about in the organ; but in proportion as they increase in size, they yield more to the laws of gravity: and if they still continue to move, they do not so readily yield to any shocks which may be given to the body. They remain more immediately in contact with the back part of the organ, when the patient is placed in a horizontal position, and with that flattened part which corresponds to the neck when he is in the erect position.

It is still possible for the calculi to move when the patient changes from one position to the other, but the change takes place the more completely the more spherical the stone is.

In fact, when the stone is round it rolls directly to the neck, when the patient changes his position from the horizontal to the erect; whence it results, that in cases of spherical calculi, the stoppage in the stream of water is more frequent, especially if the stone is smooth, than in cases of oval, or more particularly of flat stones; in this case the stream is twisted and irregular rather than stopped, for the oval and flat stone only passes to the neck, when the bladder is quite full of urine,

---

Among these remarks there are perhaps a few which have not yet been made; I submit them more particularly to the reflection of the scientific gentlemen who have meditated on, and studied this subject; fully convinced, that if they are of any value, they will draw from them some ingenious and positive conclusion.

and when the patient moves his body frequently, and so completely as to produce a sufficient alteration in the position of a non-rolling stone.

Such are nearly all the different symptoms produced by calculi when they are middle sized, and when they move in a large dilatable bladder, which receives and retains a large quantity of water. If we have many stones of this size in the organ, the patient hears, or sometimes feels the shock of one against the other, and this shock sometimes breaks one or both of them.

When the stone becomes large, whether it be round, oval, or flat, it gives nearly the same symptoms for its size, bringing it more immediately into contact with the neck of the bladder, the urine only flows drop by drop: from the double reason, that the bladder then only receives a small quantity of water, and that the stone only allows a small quantity to escape at a time; the bladder is then diminished: it is extremely sensitive, and is continually contracting round the stone, the form of which is then modified by two causes.

The first of these causes is the contraction of the organ, which, when it is in constant contact with the stone, gives it a certain shape, more or less apparent, according as its primitive form, and the position in which it first became immoveable in the bladder were more or less favourable for it to assume this particular shape.

As we have just remarked, as long as the stone

has space in the bladder, it is moved by the contraction of this organ, and by the influence of the different motions of the body; this alteration in its position takes place provided none of the diameters of the stone are larger than the diameters of the bladder. If this organ always remained healthy and dilatable, the stone would be moveable for a long time, although it might be very large; but this is not commonly the case, for the continual presence of the stone produces a contraction of the bladder, and especially of its fundus, which is at first *relative*, but afterwards becomes *absolute*, so that the diameters of the organ are thus diminished.

At the same time that the diameters of the bladder diminish, those of the stone increase, till at last it becomes fixed, and can no longer be turned in that organ, but by the assistance of the surgeon. This mechanism is exactly analogous to that by which the fœtus in utero loses the power of changing its position, by the increase of its long diameter.

In the same manner as the physical laws cause the head of the infant, which is the heaviest part, to be usually directed downwards, these same laws cause the shape of the stone to regulate the position which it may take in the bladder, at the time when the diameter of the viscus and of the calculus are such as to render the latter immove-

able, and to bring the parietes of the bladder into constant contact with it.

If the stone be round, it does not so soon become fixed, and it can increase to a greater size, without becoming so; because none of its diameters predominating over the others, it does not so soon find any point to arrest it.

If it be flat, it remains, on account of its flat surface, in that position in which it is most natural it should stop, namely, with one of the points of its circumference resting behind the neck, and the opposite point farther back, according to its length. Its longest diameter is generally placed transversely.

If it be oval or oblong, it remains in such a position that its greatest diameter is placed transversely, which is generally the case; but it may also happen that its greatest diameter may correspond to the antero-posterior diameter of the bladder. In the first case, it is situated in the most distant part of the fundus, on the other side of the prostate, which is then frequently enlarged; in the second case, one of its ends sometimes projects into the neck, whilst the other rests upon a part, more distant from it, according to the diameter of the stone.

It is under these circumstances that the stone assumes the shape of a gourd, which fact has struck many practitioners, without their being able to account for the mechanism which caused

this disposition, and which may now perhaps be better understood from the explanation we have given.

It is thus that calculi, when rendered fixed by the increase in their size, and by the contraction of the bladder, add to the causes of inflammation of the vesical mucus membrane, which generates the mixed phosphates, and deposits a morphous product on the body, which it surrounds, and thus changes it from a regular to an irregular shape, and renders it the more immoveable, the more this irregularity is apparent, and the more distressing the more immoveable it is. We see that there is in this an untoward concurrence of effects and causes, dependent one upon the other, and which every day lessen the chance the patient has of being cured.

Now, having to destroy these calculi, let us consider their physical properties as regards the mode of destroying them, as we have already considered them with regard to the symptoms which they cause when contained in the bladder.

As two acts are required in destroying them, namely, that of seizing, and that of breaking them, let us first consider their physical properties with respect to the first of these, that of seizing.

This act of seizing the calculus may be divided into that of laying hold, and that of retaining it.

In general, round stones are those which are

the most readily grasped in the bladder with an instrument, constructed on the principle *of several branches diverging on coming out of a straight tube*,* because they more readily pass into the axis of the instrument, from their spherical shape allowing them to roll towards the lowest part of the bladder, which is situated at this axis. Now the *centre of action* of the instrument thus constructed, is also exactly in this axis. But this facility of seizing them diminishes as the stone enlarges, which arises, as we know, from a spherical stone approaching nearer to the neck of the bladder, in proportion as it is larger; not from any alteration in its place, but simply from the increased length of its radius.

We are aware, also, that with spherical calculi, on account of the sort of dome they present, the operation of seizing them is facilitated.

With regard to the act of retaining the stone, a round calculus offers many advantages, when we use an instrument constructed on the same principle, for two reasons—the first is, that these stones are generally composed of oxalate of lime, or of the mixed phosphates; now the oxalate of lime calculi are rough, and consequently are more readily held; and those of the mixed phosphates are generally sufficiently soft, to allow the

* All the instruments which have hitherto been made use of in lithotrity are constructed on this plan, for instance, the "perce-pierre," the "trois branches à virgule," the "pince à forceps," and the "brise-coque."

hooks of the forceps to take sufficient hold in them. The second reason is, that the spherical shape of the stone is more particularly suited to the forceps, constructed with branches coming out from a straight tube. In fact, each branch of the forceps, when projected from the tube, becomes a tangent to the circumference of the stone, and thus allows the hooks to grasp the calculus a little beyond each point where the branches touch. And since a round body is firmly held when it is maintained by three, four, or more points of its circumference, it of course follows, that a stone of this form will be most readily fixed and retained by forceps thus constructed.

When the calculi are not spherical, we must employ other means for seizing and retaining them, since, according as they recede from the round shape, they become more flattened—a form which requires a totally different construction in the instrument.

In fact, an oval stone, which is intermediate between these two shapes, is so different in its diameters, that it does not present corresponding points for it to be firmly held by the forceps constructed in the manner described; and, for a still stronger reason, the flat stone is less calculated to be seized and held by such an instrument.

Let us, in order to be brief, leave the oval calculi, and consider what may be the difficulties we experience in grasping and holding a flat stone in

the bladder; and afterwards, we can apply our considerations to oval calculi.

In the first place, it is difficult to grasp a flat stone with these forceps, because, always lying in the bladder upon one of its flat surfaces, it cannot readily be caught between the branches, its width frustrating every attempt. It does not, like spherical calculi, admit of being seized in the bladder, by depressing the instrument from above downwards; but we must grasp it from underneath; and in order to effect this, we must pass one of the branches of the instrument under it. When we do this, the branch we wish to pass under becomes parallel to the axis of the forceps, and this axis corresponds to the antero-posterior median line of the fundus; so that, if the flat stone is lying in this fundus, its centre corresponds to the branch thus placed, and consequently it cannot be seized; for it is necessary that this branch should be at one of the edges of the stone, in order to accomplish this.

We must, therefore, either carry the branch to this edge of the stone, or bring this edge into the median line of the fundus. Now this requires that the surgeon employing the instrument in question should have recourse to violent manœuvres, which moreover are frequently ineffectual; for even if the stone is seized, it is commonly only by its edge.*

---

* It is difficult, in all cases, to seize a large oval or flat stone with an instrument constructed on the principle *of branches diverging on coming out of a straight tube.* The reason is, that the *centre of*

Now, let us consider that in general, oval, and more especially flat calculi, are formed of uric acid, or of its compounds; and consequently that, besides their form, which is not well adapted for being readily seized by an instrument consisting of three, four, or more branches coming out from a straight tube, they present a physical property which increases the difficulty—namely, that of having a hard and polished surface.

Of what use, then, is such an instrument, the branches of which are, at one part, in contact with a flat surface, and at another with a round surface, and the hooked extremities of which are at different distances from the centre of the calculus, and bear upon a hard and smooth exterior? It is evident that these branches cannot take a firm hold, and mutually sustain each other as they do with a round stone; so that, if they do retain an oval or flat calculus, it is only by the mere pressure of the branches upon its flattened surface, and not by the retaining power of the hooks.

---

action of such an instrument is always in the axis of the straight tube; so that, with it, we can seldom seize a flat or oval stone; for, in order to perform this, its edge should also be in the same line as this axis. The science is deficient in an instrument well adapted to seize calculi out of the axis of the straight tube. This can only be obtained by means of a curve at the end of the instrument. Such an instrument would also be of infinite service in many other cases.

Thus, flat stones are not adapted to be seized and retained by forceps constructed in the manner described, for the following four reasons—their position in the bladder, their form, their different diameters, and their hard and polished surfaces.

Presenting properties so different from the round stones, they must require, in the means used for seizing and retaining them, a different construction, and one more suited to their properties.

If we regard the spherical shape of calculi as a circumstance well adapted for their being held by three or four branches, which expand on coming out of a straight tube, and which can take firm hold on each part of the circumference of the body, we must search in the physical properties of flat and oval stones those means which are the best calculated for grasping and holding them; and this is the point which we now wish to overcome.

Oval and flat stones present a very remarkable physical property, and one of great service with regard to their being grasped and held: it is that of possessing two opposed surfaces.

A calculus thus presenting two opposite surfaces naturally requires, in the instrument which is to seize and hold it, a coinciding construction; and if we would use an apparatus consisting of branches coming out of a straight tube, it will be evident that it must consist of the same number of

branches as there are surfaces to the stone; that is to say, two.

Then the contact of the instrument with the calculus is different. To the two hard and smooth surfaces of the calculus are opposed the two hard and irregular surfaces of two large and flat branches. Instead of forceps, the branches of which expand like a tulip, we must substitute those which are better adapted for grasping and holding the stone by pressing upon its flat surfaces.

A flat stone will, therefore, be the most readily grasped and held by forceps consisting of two branches, as a round one is with those constructed with three or four.

We must consequently endeavour, in the construction of our instruments, to seek to develop these two principles; for, if we accomplish this, we shall then be entire master of calculi, both as regards the seizing and the holding of them.

Let us now examine the physical properties of calculi as regards their destruction, and let us see if we shall not find in those properties some circumstances fortunately coinciding with those we have just mentioned when speaking of seizing and retaining them.

If we examine different calculi, we shall perceive that, in general, large round stones are seldom formed of slightly adherent layers, whilst flat and oval ones are principally deposited in this manner.

Round stones, the greater number of which we before stated as being generally composed of oxalate of lime and of the mixed phosphates, present in their whole a great similarity. Those of oxalate of lime are hard and disposed in layers; but these layers are so firmly compacted together, by the irregular manner in which the oxalate of lime crystallizes, that they form a whole—very hard, it is true, but compact and of equal density throughout.

The mixed phosphates, when round, do not generally consist of distinct layers. This salt is deposited irregularly, and appears altogether compact, but soft and of a similar consistency throughout.

If we strike these calculi, for instance, with a small hammer, first placing them upon a table, we remark that in those of oxalate of lime the blow does not act directly on the calculus, but is considerably deadened by the irregularities which this species of stone presents; so that, instead of splitting the stone, it breaks off the irregularities in scales. If we strike it with force, the stone is at last broken, but only into two or three pieces; and it will be found that its fracture does not take place in the direction of its layers, as we shall see to be the case with oval stones composed of uric acid.

If we put a round calculus, composed of the mixed phosphates, to the same trial, we find less difficulty in breaking it; but it also is only sepa-

rated into two or three pieces: the softness of the calculus prevents the fracture extending, and separating the body into a great many fragments.

Now, if we submit both these species of calculi to the action of an instrument constructed so as to act gradually on the stone from within outwards, we find that the oxalate of lime, although very hard, readily yields to this instrument, which is the more effectual according as the part of the stone reduced to powder is more equally dense.

When, instead of a calculus of oxalate of lime, we submit to the action of an instrument gradually excavating in this manner a soft stone of the mixed phosphates, we find that this species yields more readily, and that the instrument excavates the stone with great rapidity, notwithstanding its clayey and sticky consistency tends to clog the instrument.

If, after having excavated these stones to a slight extent, we strike them with a hammer, they then break very readily into several concave fragments, which we may afterwards destroy with the greatest ease by percussion or crushing.

When, on the contrary, we submit to the action of an excavating instrument, one of the flat uric acid calculi, composed of concentric layers, this instrument fails: for the flat stone does not present sufficient surface for the *excavator*, which can only act with advantage upon a stone, the diameters of which are nearly equal.

When we employ the same instrument upon an oval stone, it produces greater effect than upon the flat one; but this effect, which can only be obtained when by chance the calculus can be held by the three or four branched forceps, is not very satisfactory; first, because the layers which, in this species of stone, are very distinct, and often of unequal density, are apt to give jerks to the instrument, and also because the dry and friable nature of the uric acid calculi and its compounds cause it to break into two or three pieces before a large quantity of powder can be obtained.

If, instead of submitting these flat and oval calculi to the action of an instrument thus acting progressively, we put them upon a table, in order to strike them with a small hammer, we at once remark that they naturally rest upon one of their flat surfaces, so that consequently a blow falls directly upon the other flat surface.

We see that there is nothing to deaden the blow; for the hammer generally strikes upon a smooth and polished exterior. If we strike sufficiently hard to break the stone at once, we remark that it splits into two, three, or four pieces, which are divided sometimes by fractures perpendicular to the layers, and sometimes by a separation of those layers.

If, instead of a heavy blow, we strike the stone lightly, it remains entire for some time; but we soon perceive cracks upon its surface, and, after

a few more blows, it separates into a considerable number of fragments.*

If we examine for the cause of this result, we readily perceive that the slight blows we have given to the stone have shaken its layers, which are thus soon disjointed one from the other, but disjointed at the same time that they are divided into small cubic portions, by numerous regular fractures perpendicular to the layers.

If we examine an oval or flat stone, cut through its greatest diameter, we readily perceive the direction these fractures would take, for we see on the surfaces, made by this section, both the irregular lines which mark the separation of the layers, and the lines passing from the centre to the circumference, which point out the direction in which the fracture will take place.

If instead of striking a flat or oval stone, we employ considerable pressure upon it, which can be readily done, for one of its flat surfaces rests upon the table, and the other presents a fulcrum which does not move, then the calculus not being able to escape from the action of the instrument,

* This fracture into a considerable number of fragments is obtained in a few seconds. If the means of performing it in the bladder, as is done outside, could be devised, it would be a very important point gained; for, according to the calculations I have made, oval and flat stones form four-fifths of vesical calculi. In the course of some time I will publish what I have done in this view.

soon separates into two or three fragments, provided the pressure be sufficiently powerful. We perceive that this continued power of pressure is far from having so considerable an effect as the quick and repeated blows of the hammer; and that consequently, in cases of thick stones more particularly, the former of the two methods produces a much less considerable effect than the latter.

Now that we have made these observations, let us consider those coinciding circumstances which the physical properties of vesical calculi present, as regards their seizing and destroying; for it is such considerations that will point out to us, in the construction of the instrument which is to accomplish these two objects, the means of arriving at that perfection which mechanism will admit of.

We have seen that round calculi can be most readily *seized* and *held* by forceps constructed with *three or four branches expanding, when projected from a straight tube*; and we have also seen that these calculi, from their form, and from the nature of the salts which compose them, allow of being hollowed from within outwards by the eccentric action of the instrument; now in this there is a fortunate coincidence, for these two mechanical means combine well together. In fact, the forceps thus constructed, holds the calculus in such a manner, that its axis, and that of the forceps, are in

the same line, and any excavating instrument requires exactly, in order that its action may be complete, that these two axis should be the same.

We have seen that oval and flat calculi, on account of the two surfaces they presented, were seized with facility with an instrument consisting of two branches, and that these calculi yielded to the pressure of an instrument, but did so more readily to percussion.* Here again is a fortunate coincidence, for the smaller the number of branches adapted to an instrument, the stronger they both are; and in order to destroy a stone by crushing, or by percussion, force is required, and the smallest number of branches we can employ is two.

* Percussion can only be made to act upon a calculus in the bladder by means of the urethra; and it cannot consequently be well performed with an instrument constructed on the principle of *branches which diverge on projecting from a straight tube.* If we consider the disposition of the branches forming the two planes between which the stone is to be compressed, we shall readily conclude that such an instrument can only be adapted to the system of crushing; for to employ percussion it is evident that the two surfaces which are to maintain the stone *must be perpendicular to the axis of the instrument;* for without this construction it is impossible to dispose two planes in such a manner as to bring them together by means of a hammer, the action of which must necessarily be transmitted through the whole length of the urethra, and takes place at the extra-vesical extremity of the instrument.

If we compare this note with the one at the 146th page, and which alludes to the same subject, we shall discover a happy coincidence from which it will be well to seek to derive some advantage.

Thus we see that the physical properties of calculi require the instruments to be differently constructed, in order to arrive at the important object of effecting their comminution in as short a time as possible, with the least movements possible, and in the most gentle manner for the bladder.

It must be well understood, that all that I have just said is in allusion to calculi, which have already acquired a certain size; for when they are small, any instrument, provided it be not constructed without study and ingenuity, as regards the act of seizing, will serve to pulverize them. For there is a time when calculi are so small, and afford so many advantages to an instrument constructed according to the size of the urethra, that it is not at all necessary to seek for other combinations to perfect the instrument.

GENERAL CONSIDERATIONS

ON THE

INSTRUMENTS.

When our thoughts are turned towards discovering the means of mechanically destroying vesical calculi, the idea on which we most willingly dwell, because it appears most satisfactory, is to combine a system of instruments, by which a stone, when once seized, may, in a short time, be reduced to impalpable powder.

If this problem were solved, it would be the perfection of lithotrity, but, unfortunately, all attempts hitherto made in this view have proved, that if such an idea be not chimerical, it differs so little from an impossibility, that it is very doubtful whether we shall ever see it put into execution.

Thus, notwithstanding the advantage which mankind would derive from seeing this chimera turned into a reality, we are obliged to abandon the thought, in order to devote our attention to the construction of a different system, the result of which shall be to reduce calculi, by repeated

fractures, into powder, and fragments sufficiently small to pass through the urethra with facility. This system of destroying calculi is certainly more in relation with the mechanical power we can obtain, if we rest satisfied with the *data* furnished by the substance to be destroyed, and by the organs, in the interior of which this destruction is to be performed.

When our ideas are fixed on this method of destroying, first the stones and then the fragments, by repeated fractures, the thought which most readily strikes us, is to seek to obtain the rupture of vesical calculi, by subjecting them to the pressure of an instrument suitably constructed to *crush* them.*

---

* There is another system, still more rapid, for obtaining the fracture of calculi : *by percussion.* In fact, what means should we adopt as the most rapid and efficacious to destroy a stone out of the bladder ? Would it not be to strike it with a hammer ? I have hopes of rendering this possible in the interior of that organ ; the idea, I foresee, will be treated as theoretical and speculative ; but I have, even now, advanced so far towards putting this idea into execution, as to take it upon myself to assert, that it is not only possible, but easy to accomplish this object ; and further, I am perfectly ready to prove and demonstrate what I advance.

The idea of the *system of percussion* is totally new ; and it could not, consequently, find a place in this part of the work, which was written some time ago. In the chapter on calculi, I entered more fully into the explanation of this system, and of its importance. It might be thought extraordinary that little mention is made of it in this chapter, if I did not warn my readers that the chapter on calculi was the very last which I wrote.

In theory, this is certainly the most rapid method, and it is, consequently, the one which would soonest produce the desired effect; we should also prefer it in practice, were we not restrained by the limits which nature imposes to the size of the instruments.

A diameter of three or four lines is, as we already know, the mean size we can give to these instruments; and it seems at first very difficult to develop in such a tube sufficient power to produce an attrition capable of separating the layers of which calculi are composed.

Although the system of crushing is the most rapid, it is not the one which was employed to perform the first operations of lithotrity; it presented a problem of mechanical surgery too difficult to be solved.

To unite in an instrument of this sort, restricted to the narrow limits of the urinary passage, the lightness, energy, and delicacy, requisite for seizing the stone in the bladder with ease and gentleness, and the force sufficient to destroy this body, was a combination too difficult to appear in the first steps of this science.

An instrument destined to act with energy on stones by crushing, must have presented great difficulties in its construction. It must unite the properties of delicacy and power; but these two conditions almost contradict each other, since by the word *lightness* or *delicacy*, we are led to ima-

gine that a small quantity of matter is employed in the construction of an instrument, and *power* gives rise to quite a contrary idea; this, therefore, could not have been the system first applied.

Two actions are requisite for producing the fracture of a calculus; the first is to seize it, the second, to break it down.

Two conditions must regulate these actions: delicacy in seizing, and force in breaking; but in lithotrity, one of them must predominate over the other, for it is necessary to seize before we can destroy; as therefore these two conditions could not be combined with equal perfection in the same instrument; it was found necessary to make a selection of one of them, and the choice fell, naturally, on *the act of seizing*, which was deemed most immediately requisite, leaving the *act of destroying* to be performed in the best manner possible.

Only one mode of destroying calculi, that of *wearing away progressively*, could have been adapted to an instrument, in the construction of which a small quantity of matter was used in order to give it that delicacy so desirable.

This system of destruction, being the easiest to discover, was the first resorted to, and has already appeared in the science under two different aspects; wearing away by *repeated perforations*, which were the first means employed; and wearing away by *excavation*, that is to say, by acting

from the centre to the circumference, which originated with us. A fundamental principle of these two methods, but more especially of the latter, is to make the destroying power act in the interior of the stone; by which means the bladder is removed from all contact with the instrument.

Attempts have been made to introduce into lithotrity other modes of acting on calculi, such, for example, as working from the exterior to the interior; but these methods are faulty in principle, as well as in what regards their secondary conditions, since they have, as a primitive defect, that of bringing the destroying agent of the stone in too close contact with the parietes of the bladder; my only motive in mentioning this is to give a more complete idea of the fundamental rules of lithotrity.

When we had solved the problems which presented the least difficulties, we naturally proceeded to overcome greater ones; it still remained a desideratum to unite in an instrument the properties of delicacy and power, in order to effect more expeditiously the destruction of a stone by crushing it, when such means of proceeding were admissible.

Deep study and numerous attempts have at last put us in possession of an instrument which combines, in a high degree, these two properties; we will hereafter make it known, under the name of "*brise-coque*" (shell-breaker); it greatly extends

the power of lithotrity, and at the same time lessens the importance of the instruments which act progressively on the stone, in as much as it renders their tedious proceedings and slow action, less frequently necessary.

Thus, then, we see, that lithotrity consists at present* of two principal systems of destroying calculi. The one effects their fracture by *progressive wearing away*; the other, by *crushing* them. The former is applicable in cases of stones, which in every direction present large diameters; the latter on those which at the same time have small and large diameters, such as oval or flat calculi. We shall see later, that although these two systems are usefully applied under different circumstances, they afford each other mutual assistance, for we often have recourse to the system *of progressively wearing away*, when the more expeditious system of *crushing* is not applicable, on account of the size or unfavourable shape of the stone.

This is the most general idea we can give of the instruments of lithotrity.

Let us now endeavour to render the subject still more clear, by laying down a few general rules to be attended to, in the construction of each of these instruments.

These rules being given and established from an anatomical investigation of the organs; and from

---

* In the month of May, 1831.

the study we have made on the physical properties of calculi, we shall be better able to appreciate the degree of perfection to which we have carried the construction of each of the mechanical means now employed for destroying vesical calculi.

First Rule. —Rectitude in a sound, being: 1st, *the most favourable shape for bringing, without effort, the extremity of the instrument into contact with a great extent of the parietes of the bladder, and more especially with its fundus*; 2nd, *for allowing the instrument to be moved backwards and forwards with facility*; 3d, *for permitting it to be rotated on itself*, all instruments of lithotrity *must be straight in that portion of them which remains in the urethra during the operation*, for a curve would render them faulty in proportion as it impeded the execution of these three fundamental properties.

Second Rule.—Since the operation of lithotrity must be performed whilst the bladder is distended with water, it follows that the instrument must unite the necessary conditions for preventing the liquid, when once introduced, from escaping during the operation; hence, 1st, *it is necessary that the instrument should be, as nearly as possible, of the same diameter throughout, and that its vesical extremity should be as little enlarged as possible*, for the urethra through which an end much enlarged passed, would be but incompletely filled by the body of the instrument, and the water would consequently escape between the instrument and the

sides of the canal; 2nd, *the instrument must be of sufficient size to fill the canal, but not large enough to distend it, and render the movements difficult;* 3d, *it must finally be constructed so as to prevent the water from flowing out between its component parts.*

Third Rule.—Since urethræ vary in size, from two lines and a half, to four and a half, it follows *that the instruments must also present different diameters.*

Fourth Rule.—The contraction of the bladder being sometimes powerful enough to expel, between the canal and the instrument, almost all the water it contains, it is necessary *that every instrument of lithotrity should allow a fresh injection to be made into that organ, in order to distend it, so that the instrument may be closed without any danger.**

Fifth Rule.—Since the bladder varies in its antero-posterior diameter from two to three inches, on account of its contraction, *a lithotritic instrument must be constructed, so that its branches may expand sufficiently to seize the stone, and yet not project more than two inches and-a-half from the tube which contains them.* The instrument must also admit of *the projection of the branches being diminished, if circumstances should require it;* and this is the more requisite, since those bladders which

---

* I am here only alluding to the instruments which act by *progressive wasting* on the stone, and which consist of three or four branches, for these alone are apt to become entangled in the bladder.

contain the largest stones are generally the least capacious.

Sixth Rule.—When an instrument is expanded, and is in action in the interior of the bladder, the spot where the branches project from the tube is almost always in close contact with the neck of that organ; hence it is necessary *that the branches should have free motion, without affording a possibility of pinching at the part where they unite, and should always preserve the same distance between them, whether projected from, or drawn into the tube.*

Seventh Rule.—The bladder sometimes violently contracts during the operation of lithotrity, and presses upon the branches of the instrument which, when drawn towards the neck, are compressed by this part of the viscus, so that the surgeon is no longer master of the expansion of his forceps, and his manœuvres are totally impeded. It follows, therefore, *that the branches of every lithotritic instrument should be supported when they project from the tube and are expanded in the bladder, and that their expansion should not be entirely entrusted to the elasticity of the metal.*

Eighth Rule.—The object in constructing a lithotritic instrument being to bring a mechanical agent into action in the interior of the bladder, where the surgeon is unable to see in what manner it acts; it follows, *that every instrument for lithotrity must be graduated;* so that by means of certain signs placed at the extra-vesical extremity

of the instrument, *the operator may be enabled to ascertain what is going forward at the intra-vesical portion.* Marks well contrived are therefore of the greatest importance.

Ninth Rule.—Some bladders are very irregular, and their superior and posterior parts, although distended with water, are sometimes forced from the sacrum towards the neck of the bladder, either by the contraction of the viscus itself, or by the pressure of the intestines which are pushed down by the abdominal muscles; it follows, therefore, that an instrument, destined to seize large calculi, which require a large expansion of the branches, is faulty in its construction, *if the branch which is above terminates in a hooked extremity; it is the more faulty the further the branches project from the tube to grasp the stone, and the smaller the size of the bladder.*

Tenth Rule.—Since it is necessary, under certain circumstances, to discontinue the operation of lithotrity, either on account of a great degree of sensitiveness in the patient, or because of a violent and permanent contraction of the bladder, it follows, that it is not sufficient for an instrument to *grasp* the stone with facility, *but it must relax its hold with equal ease;* and as this becomes more frequently necessary in operating on large calculi, this property must predominate more especially in those instruments destined to act in such cases.

Eleventh Rule.—Since the excavation of large calculi produces a very considerable quantity of powder, which would clog the action of the "évideur" (excavator), it follows, that *an instrument intended to excavate such calculi, must afford the facility of injecting water into the bladder to wash away the superabundant powder, even whilst the instrument is in action.*

Twelfth Rule.—Since that portion of the instrument which destroys the stone by *progressive wearing away* must be removed as far as possible from the parietes of the bladder, it follows *that this action must proceed from the centre of the calculus to its circumference;* for were it otherwise, the destroying agent would be in almost immediate contact with the interior of the organ.

Thirteenth Rule.—Since the action of the instruments upon the stone must be performed with the greatest regularity, both as regards the action of seizing and that of breaking, and since the exact performance of this must depend entirely upon the manœuvres of the surgeon, it follows that *no part of a lithotritic instrument must be left to act by means of springs, the movements of which are in a great measure independent of the surgeon's will.*

Fourteenth Rule.—Since it is necessary that the different parts of an instrument should play with facility one upon another, in order that the surgeon may have all the precision and delicacy of

his tact, it follows that the instrument *must not only admit of this free and easy play*, but it must also be so constructed as to render it easy *to take it entirely to pieces, so that it may, in all its parts, be thoroughly cleaned*. Without the observance of this condition in an instrument, there cannot be sufficient precision in the manœuvres.*

Having formed some idea of the principal points to be attended to in the construction of the instruments of lithotrity, let us examine those which already exist, and consider the motives for which they were imagined; let us study their construction, their mechanism, and their action on the stone, independently of any connection with the organs. In the chapter which treats on the operation, we will bring them into contact with the organs, and will enter into the important study of their manœuvres.

* A great number of instruments have been invented to perform the operation of Lithotrity, and more especially in France, but they have proved unfit for use, as the greater part of them deviate from one or the other of the rules here laid down, and are thus the more defective and inapplicable, in proportion to the importance of the rule neglected; many of these instruments are faulty from the non-observance of 5, 6, 7, or 8 rules, and unfortunately operations attempted with them have sometimes caused the death of the patient; but can such fatal terminations be laid to the account of Lithotrity?

A

CONSIDERATION OF EACH OF THE INSTRUMENTS

ADAPTED TO

LITHOTRITY.

In the preceding part, but more particularly in the *preliminary considerations, and in the examination of the bladder and calculi*, we stated, that we did not think it right that the destruction of vesical calculi should be accomplished by one single instrument. For this instrument, however ingeniously conceived, must meet with stones which will be unfavourable, either to the action of seizing or destroying. If we consider how materially calculi differ in their nature, but more particularly in their shape, we shall readily conceive that those which are composed of a fine smooth grain will yield to the instruments which act progressively, but will be unfavourable to the action of the crushing instruments; whilst other calculi formed in layers, not firmly united together, and composed of a salt of a friable nature, will, on the

contrary, be easily destroyed by the crushing instruments, or by those which act by percussion, and will with difficulty be reduced by other means. It will be easily understood, that an instrument well calculated for seizing a round stone will be totally incapable of seizing a flat one, and *vice versâ;* that an instrument well adapted to grasp a stone in a large bladder with smooth parietes, would be but ill calculated to take one in a small bladder with irregular parietes; finally, that an instrument suitably constructed to destroy entire stones, or rather to break them into fragments, will be badly contrived for reducing the irregular fragments of a stone already broken into still smaller pieces and into powder.

It is only necessary to make a trial of the instruments we are about to examine, in order to find a convincing proof of the justness of these remarks, which we sum up more briefly in the following proposition:—*To proceed as rapidly as possible in the destruction of vesical calculi, and at the same time with safety to the organ, it is absolutely necessary to have recourse to lithotritic instruments differently combined.*

Let us now proceed to examine these combinations, which are four in number.

The first is the instrument which I have called "*perce-pierre*" (stone-borer), or *three branches with a simple drill;* this instrument is suitably constructed to destroy small round stones of five or

six lines in diameter with facility, and pretty rapidly; but its action is merely to make a hole a little larger than the drill itself. (See pl. 1, fig. 1, 2, 3, 4, 5, 6, 7, 8, 9.)

The second combination is my instrument, "*trois branches à virgule*" (three-branched with a comma); its mechanism for seizing the stone is the same as in the preceding instrument, but as regards the act of destroying, it is capable of producing in a stone an excavation of ten lines, and that in one attack; this is effected by means of a small steel blade, which projects from the perforating drill, and resembles the typographical mark called a *comma*. This instrument is well adapted to destroy spherical stones of ten or twelve lines in diameter, and oval stones of this dimension in their smallest diameter. (See pl. 1, fig. 10, 11, 12, 13, 14, 15, 16, 17, and 18.)

The third is my apparatus "*évideur à forceps*" (forceps-excavator); it is called "évideur," because it excavates spherical calculi of from fourteen to twenty-four lines in diameter; and "à forceps," because it grasps them in the same manner as an accoucheur does the head of an infant with his forceps.

This instrument, from the disposition of its component parts, is well adapted *to seize and break round and very large calculi in contracted bladders.*

Lastly. The fourth combination is my instrument "*brise-coque*" (shell-breaker), so named

from its being especially destined to crush the fragments resulting from the action of the *excavators*; these fragments, from their concave shape, resemble egg-shells.

The "brise-coque" adds to the power of comminuting fragments, the still more important property of seizing, and rapidly destroying flat calculi, which, from their shape, are unfavourable to the action of all the other instruments. (See pl. 3).*

* We see that the "brise-coque" is here considered as secondary, and destined to terminate an operation begun with the other instruments. In effect, I have always employed it in this manner, and have, for this reason, defined it in the last place. If, however, I had to recommence my work, I should place the "brise-coque," and its system of destroying calculi, in the first rank; for, as I said in the *generalities* preceding the description of the instruments, the *system of crushing* being the most rapid and efficacious, must always be the first resorted to whenever it appears applicable.

The more I operate, the more I feel convinced of this. Formerly I commenced an operation with a simple "perce-pierre," or "trois branches à virgule," to weaken the stone; but I most frequently lost much time, before producing with these instruments as much waste in a stone as I can with the "brise-coque" in the course of a few seconds; for this reason, I now always begin with the "brise-coque," unless the stone is evidently very large and round, which renders it quite unfavourable to its action; then the instruments which act progressively on the stone must be employed, the action of which is, as it were, to prepare the calculus for receiving the attacks of the "brise-coque." If, therefore, I should write subsequently on this subject, I should change the manner of arranging the different systems of destroying calculi by lithotrity, and should reverse the present order, by considering the other instruments as accessories to the "brise-coque," and not this instrument the acces-

Such are the combinations which are applicable to destroy vesical calculi. We shall see that as the difficulties increase, that is to say, as the stones become larger, the instruments become more elaborate, and afford more resources for the surgeon.

---

sory of the former. This will appear natural and correct to those who have thoroughly understood my *generalities*.

If, as I have reason to hope, I discover the means of bringing the *system of percussion* into action, which is still more expeditious and powerful than *the system of crushing*, then the "brise-coque" will occupy the second rank for breaking entire stones, and will only be employed to pulverize the fragments, for which it was primitively and solely intended.

ON THE

PERCE-PIERRE.

Motive for which this Instrument was constructed.

The "perce-pierre" is the first instrument with which a cure was obtained by lithotrity.* It is one of the earliest productions of this science; and the motive which led to its construction, was to arrive at the important result of curing, by mechanical means, and without incision, patients afflicted with the stone. A considerable number of surgeons have already attained this end, but only in those cases in which the power of the "perce-pierre" was in relation with the size of the stone, and according to the greater or less facility with which the patient could support the frequent operations this instrument requires, and the repeated manœuvres rendered necessary at each operation.

The manifest insufficiency of the "perce-pierre"

* In the introductory observations, we stated this instrument to be the fruit of the ingenious conceptions of several medical gentlemen.

induced me to commence my labours in lithotrity; but an acquaintance with this instrument is valuable for two reasons—the first is its utility in cases of small calculi; the second, that it may serve as a sort of introduction to the science, and will afford us a point of comparison. At the commencement of my practice I often employed this instrument, and my attempts were attended with success, because I only used it when its action was sufficient to destroy the stone rapidly; and now, I always use it in cases of one, two, or three small oval or round calculi.*

* I have lately discovered in the "perce-pierre" a property till now unobserved, which I have rendered efficient by introducing certain modifications in its construction, and by making some additions, which serve as accessory instruments, in order to develop and bring into action the property of which I am speaking; it consists in enabling the surgeon to break into fragments the shells of excavated stones, by communicating to them, through the medium of the drill, the shock of a hammer. This new mode of proceeding, which I have called *system of percussion*, I employed, for the first time, on a seaman, operated upon publicly at the Military Greenwich Hospital; and it constitutes, with the systems of *excavating* and *crushing*, three different means of destroying vesical calculi. I intimated before, in the *examination of calculi*, how important this new method might subsequently become; at present I only point it out, and will give a more precise idea of it when I have studied it more deeply.* With respect to the system *of repeated*

* This note was written some time ago, but I let it remain because it is to the advantage of the "perce-pierre;" since then, however, this system has become so important, that I have been induced to seek for other means of putting it into practice; for the "perce-pierre" only ad-

Construction of the "Perce-pierre."

General Idea.—This instrument, represented (Pl. 1. fig. 1 & 2,) consists of an external and an internal canula; the former, a simple tube, receives in its interior the internal canula, which terminates in three elastic branches, between which the stone is seized. A central rod, or drill, presenting at its extremity a denticulated head, moves with facility in the internal tube, and is rotated on itself by means of a pulley turned by a bow, which motion causes the drill to perforate the stone.

Examination of the different parts which compose the "Perce-pierre."

External Canula.—It is a tube (fig. 1. *a. b.*) exactly cylindrical, about nine inches in length, and three and a half in diameter. The extremity (*a*) is cut perpendicularly to the axis of the instrument; the other extremity (*b*) forms a continuation with a solid square (*c*), which I have called the

---

perforations, I allow it to subsist in this work, although I banish it from my practice as often as the stone is of sufficient size to require several perforations to be reduced to fragments.

---

mits of its being employed in cases of spherical calculi, and even then it is not very powerful. I will here make rather a singular remark on the "perce-pierre." Speaking generally, this instrument can accomplish every thing, but, with the exception of seizing and destroying small spherical calculi, it performs every thing badly. In lithotrity, on the contrary, every thing must be well performed.

"*armure*" (armour), because, on account of its solidity, it is destined to protect the tube from the pressure of the screw belonging to the mortise of the "*point fixe*" (fixed point). Next to the "*armure*," we observe a sort of capital (*d. d. d.*), called "*pavillon externe*"* (external pavillon), because it is joined to the external tube of the instrument. Four things are to be remarked in the external "*pavillon*:" the first is the mass of steel (*d. d. d.*) of which it is formed; the second is a screw (*e*) which traverses this mass and presses upon the internal tube, so as to fix it at will with the external canula; the third is the stopple (*h*), destined to fill up a hole by means of which an injection may be made into the bladder through the instrument; the fourth is a sort of cap (*i*), which covers a box, in which is put a cork to hinder the water from escaping between the external and internal tubes.

Internal Canula.—Let us examine it on the second figure, where the branches are expanded. It consists of a steel tube (*a. a.*), which fits in the external canula, and plays with facility in its interior. The internal canula is divided at its vesical extremity into three elastic branches, which ex-

* In describing the instruments, I have called "*pavillon*" that part of them which, in the manœuvres, serves as a support or resting-place for the hand of the operator; every instrument of lithotrity has an external and internal pavillon; the former attached to the *external*, the latter to the *internal* part of the instrument.

pand when pushed out of the external tube by their own elasticity, and close together again when drawn into its interior.

Each of the branches is armed with a claw, which, when the instrument is closed, cover each other (see fig. 1). The three branches must, therefore, be of unequal length. At the other extremity of this canula is a piece (*b. c.*), which is named "*pavillon interne*;" it is screwed to the extremity of the internal canula, and presents two parts to be considered. The first is the cylinder (*b*), by means of which this piece is screwed to the end of the internal tube; and the second is a little cap (*c*), similar to the one before mentioned as belonging to the external canula. This cap is equally destined to cover up a little box, in which is put a cork to prevent the water from coming out between the internal canula and the central rod of steel, or drill, destined to pierce the stone. Let us now examine this rod, which is called "*perforateur*" (perforator), to shew the nature of its action.

On the Perforator.—It is a rod of steel (fig. 2. *g. h.*), which passes through the interior of the internal canula, and plays with facility, although it fills it pretty exactly. At the extremity nearest the branches, this rod presents an enlargement made into the form of a drill, and on which we remark, at the three points corresponding to the openings between the branches when the

instrument is closed (fig. 1), three little projections, which enlarge the head of the drill without increasing the size of the end of the instrument, for the branches are depressed in the sort of grooves which separate these projections.

The other extremity of the *perforator* is of a conical shape, but not pointed. It is received in the tube which is found at the end of the little stem (*d.* pl. 5, fig. 2.) belonging to the "*chevalet,*" when this mode of maintaining the instrument is made use of; but when my "*point fixe*" and *rectangular bed* are employed, it enters into the tube of a particular piece, which I have called "*repoussoir à main,*" (pl. 4. fig. 6.) because it pushes the perforator forward. We will examine it later.

A pulley (*k.* pl. 1, fig. 2.) is fixed on this extremity of the perforator by means of a screw.

Mechanism of the "Perce-pierre."

When the "*perce-pierre*" is closed (fig. 1), its vesical extremity has the shape of an irregular olive, marked with longitudinal furrows. The head of the perforator is enclosed between the three branches, which, however, allow the three little projections, to which we before alluded, to be seen.

The internal tube projects about three inches beyond the "*pavillon*" of the external tube; and the pulley is nearly in contact with the cork box of the internal tube.

When the instrument is open, as is seen (fig. 2), the branches diverge from each other by their own elasticity. They expand the more, in proportion as they are made to project further from the tube, which is effected by bringing the internal "*pavillon*" nearer the external one.

The *perforator* has free motion, and if it be withdrawn towards the infundibulum formed by the branches, it leaves an open space in which the stone may be received. If we make each of the projections placed on the sides of the drill correspond to each of the branches, the branches are not only supported and prevented from yielding, but they are also made to expand in direct ratio to the force used in drawing the drill between them.

If we observe how the branches close together, we shall see that, by placing the two longest on a horizontal plane, there is possibility of the bladder being seized between them. This may also happen between the two shortest: but it cannot take place between the longest and shortest; for the hook of the middling-sized branch being interposed between the two others, their claws are not in immediate contact.

Action of the "Perce-pierre" on Calculi.

If, with the "*perce-pierre*" (stone-piercer), we seize a small round stone, we shall find that in general it only rests against the hook of the short-

est branch, and that the claws of the other two do not take hold on its surface. (Fig. 3.)

If we seize a stone of twelve or fourteen lines in diameter, only two of the claws are commonly brought to bear upon it (fig. 4), and sometimes only one. We see, therefore, that the difficulty of bringing all the claws at once upon the stone is in direct proportion to its irregularity and increase of size. A stone of twelve or fourteen lines in diameter is, however, often firmly grasped.

If we attempt to seize an oval stone, we find that it is generally badly held; for most frequently it is grasped by two of the branches, and the third tends rather to force it out of the forceps than to retain it there. A stone of this shape is, however, sometimes grasped with sufficient firmness by the branches to allow the perforator to act. The more an oval stone is flattened, the less firmly it is held.

It is impossible to seize an entirely flat stone well.

If we attack calculi with this instrument, we perceive that it makes holes of three lines and-a-half, which penetrate through a small stone of from five to six lines in diameter, but only extend to the two-thirds of the thickness of a stone which is an inch in diameter. (Figs. 4, 5, 6, 7.) From this we may conclude, that this instrument is sufficient to destroy rapidly small calculi of six lines, but that its insufficiency to

produce the same effect on larger stones is greater in proportion as they increase in size.

If we continue to perforate a spherical or oval stone of from twelve to eighteen lines in diameter, we shall find that the three or four first perforations work on the stone effectually; but, as the holes become more numerous, the drill has a greater tendency to enter into those which have been previously made. Sometimes it falls clear in; at other times, it rests upon the edge, and falls in after a few movements of the bow. The further a stone is from being spherical, the more frequently do we meet with this circumstance; for the more it is irregular, the more likely it is to be taken in the same situation, and to present the same part of its surface to the perforator.

It sometimes happens that when the drill has made a hole near some others, it becomes entangled in the previous perforations which were formed in the centre of the stone, and from which it is disengaged with difficulty. Sometimes the neck of the drill is fixed against the irregular edges of one of the holes, and the surgeon would be embarrassed to withdraw it, even if he had the stone in his hand.

When the calculus is covered with holes, we perceive that the branches of the forceps are easily entangled in these perforations, from which they are sometimes quickly disengaged; at other times, with some difficulty; and, in certain cases, with-

out the assistance of the hand, it is utterly impossible. This circumstance, as well as the preceding ones, bring us to the conclusion that sometimes the employment of this instrument is accompanied with very great danger. (The 4th, 5th, 6th, and 7th figures, convey an idea of the insufficiency of the "perce-pierre"—the 6th figure especially, which represents the instrument in the act of performing its thirty-first perforation. This number of holes cannot be counted in the stone; but the ten which are wanting result from the perforator having made ten useless attacks by entering into holes previously made: the figure shews the drill on the point of making another fruitless attempt.)

If, in the last place, we examine the action of the "*perce-pierre*" on fragments, we shall find that if the fragment be nearly round, the action of the drill is sufficient, and is well adapted to destroy it, but if the fragment be irregular, it is badly seized in proportion to its irregularity, and especially if it should assume a flattened shape. In this case it is grasped a considerable number of times without being comminuted; sometimes, only held by two of the branches, it escapes, when we try to crush it by the pressure of the drill; if, on the contrary, we seek to destroy it by means of the bow, which the hardness of the fragment often renders necessary, then the perforator does not turn, for being forced down towards the sort of funnel formed by the branches, it is held too tight

to be rotated; the same inconvenience attends its action on entire flat stones. This is one of the reasons which renders the "*perce-pierre*" insufficient, even in cases of small calculi.

If we employ the "*perce-pierre*" on calculi composed of lime, we find that the drill soon becomes clogged, and that, after a few movements of the bow, its progress in the stone is slow, on account of the facility with which the spaces between the teeth become filled with the greasy, plastic powder produced by certain calcareous, and even by other sorts of stones.*

If now we examine the shape of the fragments resulting from the action of the "*perce-pierre*," after having continued this action, until these fragments are sufficiently small to pass through the urethra, we shall find that, for the most part, they are angular and irregular; sometimes they present the shape of a crescent, the two extremities of which are sharp.

The fragments are not, it is true, often of this unfavourable shape, but this form which results from the primitive disposition of a portion of stone, can frequently be traced to the smaller pieces, and hence they are voided by the patient with difficulty and fatigue; for when the fragments are produced by the pressure of the drill, rather than by the action

* Unsuccessful attempts have been made to remedy this defect, by boring holes in the drill head, directed from the teeth to the stem.

of its rotatory movement, then they are generally triangular, with acute angles; for the pressure of the perforator is sometimes sufficient to split a large portion of stone, but not to crush it entirely, and then the fragments usually assume the unfavourable shape we have just mentioned.

Finally, when a large stone is seized, it is often difficult to let it loose; not if we manœuvre out of the bladder in the open space, but if we try to perform this after having surrounded the stone and forceps with our hand, in order to imitate a contracted bladder. We see that the calculus is retained within the grasp of the instrument by the parietes of our hand, and that the forceps cannot be closed. We see that it is more difficult to disengage the stone from the branches, in proportion as there is a greater number of perforations, for the drill often sinks into one of the holes, and does not find a point to rest against in order to push out the calculus.

After having verified the truth of these assertions, we may conclude that it is often difficult to loose a large stone in a contracted bladder, when this stone has been seized by the three-branched instruments, and this may certainly be considered as another defect.

ON THE

TROIS-BRANCHES A VIRGULE.

Motive for which this Instrument was constructed.

We must have remarked that there was an evident disproportion in the "*perce-pierre,*" between the action of seizing and destroying calculi. We already know that this instrument can grasp and firmly hold a stone of twelve or fourteen lines in diameter, but that its action is limited to a simple perforation of three and-a-half lines. It was therefore important to turn to greater advantage its properties for seizing and maintaining, by rendering more rapid and effectual its destroying agents. To this end, I constructed the "mandrin à virgule" (drill with a comma), which has the advantage of adapting to the simple combination of a three-branched instrument, *the system of excavation.*

This alteration is very great, and constitutes a totally different combination, since it entirely modifies the instrument in its action of destroy-

ing; we will, therefore, proceed to examine and study the "trois-branches à virgule."

Construction of the "Trois-Branches à Virgule."

General Idea.—This instrument, represented (pl. 1, fig. 10 and 11) resembles the "perce-pierre" in those parts which seize the stone: it consists of two tubes, one of which is contained in the other; the internal tube is terminated by three elastic branches, armed with claws; but instead of destroying the stone with a simple drill or borer, like the "perce-pierre," it has the power of enlarging the hole previously made by the perforator, by means of a small, steel, denticulated *tongue*, made to project gradually from the drill. This little *tongue* or *blade* is called "virgule" (comma), and acts by means of a peculiar piece of mechanism placed at the extra-vesical extremity of the instrument.

A Study of the different Parts which compose the "Trois-Branches à Virgule."

It is not necessary to renew the description of the external and internal canula which so nearly resemble those of the "perce-pierre;" there is only a trifling difference in the curvature of the branches. We will, therefore, immediately examine the "mandrin à virgule."

It is a steel tube, containing a steel wire, which plays with facility in its interior. (The figs. 15 and 16

represent a section of the tube, and shew the wire in its interior.) By means of this central wire we can communicate a movement from the extra-vesical end of the drill, to its vesical extremity.

The "*mandrin à virgule*" is enclosed in the internal tube of the instrument, in the same manner as the perforator of the "*perce-pierre.*" (Figs. 10 and 11.)

When placed in the internal tube, two parts are worthy of consideration: its vesical extremity, which includes the drill and the "virgule," and the apparatus at the extra-vesical extremity, which allows us to communicate to the "virgule," while it is rotated by means of the bow, an impulse which forces it out of the head of the drill.

Vesical Extremity.—It is of a cylindrical form, about five or six lines in length, and two and a half or three in width (fig. 15 and 16), and is fixed to the tube which forms the body of the drill; it presents a square mortise (*a.* fig. 16), destined to contain the "virgule" (*b.* fig. 16), which is a little blade, nearly triangular, and can either be drawn into the cylinder, or forced out, as may be seen by comparing the figures 16 and 18; when it is drawn in (fig. 18), it exactly fills the mortise, and we can only see the asperities with which it is marked at its point and exterior side. When, on the contrary, it is pushed out (fig. 16), the edge, which is armed with teeth, forms, with

the axis of the cylinder, an angle of 45 degrees, and we see that it projects from the mortise, the two sides of which firmly maintain it.

At the denticulated extremity of the cylinder there is a small projection (*c.* fig. 16), similar to those which we observed on the *drill-head* of the "*perce-pierre*;" it renders the perforation made in the stone larger than the diameter of the cylinder, and also keeps the drill clear during its rotatory action.

At the same extremity, and on one side, the cylinder is beveled (*d.* fig. 15): this is to take off the sharp edge, which would otherwise exist at this part during the manœuvres; this edge, as we shall afterwards see, would be injurious.

The end of the cylinder is marked with deep teeth of a diamond shape.

Extra-vesical Extremity.—It consists of that portion of the instrument which extends beyond the internal "pavillon," and forms what I have called the "monture." (See either of the figures which represent the entire instrument. In our description of the "monture," we will refer to the 11th figure.)

We first observe a piece marked (*a. b.*), square at (*a.*), and rounded off at (*b.*); at (*b.*) there is a sort of hemisphere (*c.*), which is moveable, and can be rotated on the point where it joins (*a. b.*); the extremity (*a.*) enters into square hole found in the piece (*d. e.*) as far as (*d*); we next find a

pulley (*g.*), and a portion of tube (*h. k.*), which completes the "monture."

We will now endeavour to be better understood without having recourse to these details.

The "monture," by what we have just said, is composed of two parts; one of which consists of (*h. k. g. d. e.*), forming an entire piece; the other of (*a. b. c.*), for although the little hemisphere (*c.*) can be rotated on (*a. b.*), it is, however, of a piece with it.

In the portion (*h. k. g. d. e.*) there is a canal extending from (*h.*) to (*d.*) which receives the tube of the "mandrin à virgule;" a screw (*o.*) traverses the piece (*h.*), and dips into a hole in this tube, so that we can fix the portion (*h. k. g. d. e.*) with the "mandrin à virgule," when it is found necessary by means of the screw (*o*).

The piece (*a. b. c.*) enters into the square hole of the piece (*d. e.*) as far as (*d.*); it can be screwed to the extremity of the central wire of the "mandrin à virgule," and at the same time moving with facility in the square hole which receives it, it follows, that if, with the left hand, we take the portion (*h. k. g. d. e.*) which is fixed to the drill by means of the screw (*o.*), and with the right hand seize the piece (*a. b. c.*) by the hemisphere (c.), we shall be able to move (*a. b. c.*) backwards and forwards, which movement is communicated to the central wire of the drill. This wire being jointed with the "virgule" in the interior of the cylinder by

means of a bolt, it is evident that the "virgule" itself is moved in such a manner as to determine its projection from the drill.

We will terminate what we have to say on the construction of the "monture," by pointing out a screw at the point (*s.*) which penetrates through the piece (*d. e.*) and presses upon (*a. b. c.*), so that this piece may either be rendered fixed or moveable.

Mechanism of the "Trois-Branches à Virgule."

When this instrument is closed (fig. 10.) its extremity has the form of an olive rather more elongated than that of the "*perce-pierre.*" The cylinder which contains the "virgule" is visible between the branches; the mortise in which this little *tongue* is placed, is directly behind the middling-sized branch; the little projection which serves to keep the drill free, is situated between the two shortest branches, and the beveled side corresponds to the opening existing between the longest and shortest. The advantages resulting from placing the "mandrin à virgule" in this manner, are, 1st, that the branch, placed before the "virgule," should conceal its asperities; 2ndly, that the little projection should not enlarge the end of the instrument, as it would if it were placed behind either of the branches; and 3dly, that the beveled side of the drill should prevent the asperities, which surround the cylinder, from being in contact with the neck

of the bladder, when the instrument is depressed, in order to seize the stone between the two branches to the opening of which the beveled side corresponds. The portion (*h.*) of the "monture" is placed immediately before the *cork box* of the internal "pavillon." The piece (*a. b.*) is drawn as far as possible out of the square hole, for it is only by this means that the "virgule" is made to enter into its mortise. The screw (*s.*) is tightened upon the piece (*a. b.*), which it holds firmly, and consequently keeps the "virgule" in the interior of the cylinder.

When the "trois-branches à virgule" is open, the forceps is similar to that of the "perce-pierre," having about the same expansion. The drill plays with facility in the interior of the instrument in the same manner as the *perforator* does in the interior of the "perce-pierre;" it can also be drawn into the *funnel* formed by the branches, in order to expand and support them.

When the "virgule" is drawn into the mortise, the "monture" remains the same as when we examined it with the instrument closed. If, on the contrary, the "virgule" projects from the mortise, the angle which it forms with the cylinder is larger in proportion as it projects further. (Fig. 16. shows the different degrees of projection of the "virgule.") The only difference to be seen in the "*monture*" is, that the piece (*a. b. c.*) is thrust

deeper into the square hole of the piece (*d. e*). We already know that this movement causes the projection of the "virgule," since it pushes forward the wire which governs it.

If we wish to keep the "virgule" at a certain degree of projection, we have only to turn the screw (*s.*), which renders the piece (*a. b. c.*) immoveable.

Now, to resume: first, the "virgule" remains in the interior of the drill head, when the piece (*a. b. c.*) is drawn, as far as possible, out of the piece (*d. e.*); and, secondly, its projection from the drill head is more considerable, in proportion as the portion (*a. b. c.*) is made to enter further into the piece (*d.e.*), two marks found on (*a.b.c.*), enable the surgeon to regulate the movements of this little *blade*.

Action of the "Trois-Branches à Virgule" on Calculi.

The action of this instrument on calculi may be analysed, and is found to consist of three distinct divisions of time.

The first I have called "temps de perforation" (time for perforating), of which we may form some idea by examining the (12th figure); during this time, the drill penetrates into the stone as far as the hook of the shortest branch.

The second I have called "temps d'évidement" (time for excavating) during the performance of which the "virgule," by gradually projecting from

the mortise which contains it, makes a central excavation in the stone, the median section of which bears some resemblance to an isosceles triangle with one obtuse angle corresponding to the hole through which the *perforator* penetrated into the stone. (See 13th figure, in which the "virgule" having attained its full development, has effected an excavation in the centre of the stone, resembling a cone with an obtuse angle, and has even commenced the third action, to which we will now direct our attention.)

I have called it "temps de retraite" (time for retreating), which immediately succeeds the action of excavating. During the performance of the *retreat*, it is not the teeth placed at the end of the drill, nor those found at the extremity of the "virgule," which act on the stone, but those existing on the external side of this little *blade*.

It is easy to conceive that the hole through which the drill perforated the stone, when the "virgule" was drawn into its mortise, cannot possibly admit of its being withdrawn, when the "virgule" has attained a considerable degree of projection; and it is by applying this circumstance with advantage that the instrument is endowed with sufficient power to reduce a large stone into fragments in one attack. We have given an inclination of forty-five degrees to the "virgule," as being the most favourable for rendering its action on the calculus as eccentric as possible, and also

for causing its external teeth, when it projects from the drill, to act effectually upon the stone during the accomplishment of the *retreat*, which fractures the calculus from the part furthest from the operator to the portion nearest him.

The eccentric action of the "virgule" produces an almost cylindrical excavation of about ten lines, for, from the axis of the drill to the extremity of the "virgule" there are five lines, which, being doubled by the rotatory movement, form the ten lines in question. (This will be better understood after examining the 13th figure, which represents the "virgule," about to complete the action of *retreat;* and on the point of breaking the calculus, which is effected by means of a peculiar movement in manœuvring the drill bow. The 14th figure shews the state to which a stone is reduced after the "virgule" has completed its action; and by looking comparatively at the fragments of stone (fig. 14); and at the entire stone (fig. 5), we shall be enabled to form some idea of the difference between the action of the "trois-branches à virgule," and that of the "perce-pierre;" the two calculi were of the same diameter, and were attacked once by each of these two instruments.)

We may from this conclude, that with the "trois-branches à virgule" we can in one attack reduce the greatest part of a stone of an inch in diameter into powder, and must almost necessarily

break it, either when the "virgule" is made to protrude from the cylinder which contains it, or when the movement of *retreat* begins, or is about to be terminated.

The surgeon's principal object must be to prolong the action of the instrument as much as possible, the result of which will be to produce a large quantity of powder, which is voided with much greater facility than the fragments.

This instrument adds considerably to the power of lithotrity, by enabling the surgeon to perform the operation much more rapidly; it only requires that he should seize, and act once upon the stone, in order to reduce it to a state which the "perce-pierre" would not perform in numerous attempts: for very frequently the stone is grasped by the branches of the "perce-pierre," but the *perforator* does not act upon it.

The "trois branches à virgule" may be employed to destroy spherical calculi which do not exceed an inch in diameter, and oval ones of this dimension in their smallest diameter.

(The 12th figure represents the "trois-branches à virgule" attacking for the third time an oval calculus, which will this time be broken into fragments; the two first attacks took place at the two extremities of the stone, and not at its centre; this is almost always the case, for if with the three-branched forceps we wish to seize successively ten oval stones, the action of the instrument will every

time be as defective and imperfect. This may be accounted for by this instrument being badly adapted to the form of oval calculi, which, for the most part, are only maintained by two of the branches, and the third pressing against the end of the stone, tends to force it from the grasp of the two branches which retain it. To find an instrument suitably constructed to act centrally and powerfully on oval calculi, is a problem yet to be solved, and one of the greatest importance; for nine times out of ten, that an oval stone with a polished surface is grasped by one of its extremities, it slips away from the branches, at the moment that the drill-bow commences its action.)

The object of my present labours is to construct such an instrument, and I have reason to consider myself in a good path.

ON THE APPARATUS

EVIDEUR A FORCEPS.

Motive for which this Instrument was constructed.

Although the action of the "trois-branches à virgule" is very energetic, since it can produce an excavation of ten lines in one attack, this instrument is not, however, sufficient to excavate calculi exceeding ten or twelve lines; for comparatively to the size of such calculi it only makes a hole, and does not produce the important result of breaking them into fragments, or of reducing them sufficiently to render this rupture easy.

Besides, a spherical calculus of twelve, fifteen, eighteen, twenty, or twenty-four lines in diameter, is seized with greater difficulty by the three-branched instruments; for as the stones increase in size, they approach nearer to the neck, and do not correspond to the widest expansion of the forceps. It is clear that the surgeon, by pressing upon the cervix with an inflexible instrument of steel, may forcibly seize a voluminous stone, but we

have already laid down as a general and important maxim, that force must never be employed in performing the operation of lithotrity. Any instrument that requires these muscular exertions, must be rejected, and another, more suitably adapted to grasp and destroy large calculi, by delicate and gentle manœuvres, must replace it. The greater resources an instrument possesses, for accomplishing all that is necessary to reduce into fragments and powder a large stone, contained in a contracted bladder, the nearer it approaches to perfection. The three-branched forceps is far from comprehending in its attributes the necessary properties for answering all the wants of the operator; consisting of three inflexible and elastic branches, it grasps the stone in the same manner as a clumsy hand would, with stiff, unjointed fingers; it does not sufficiently encircle the calculus, and in this it is the more defective in proportion as the stone is more voluminous.

The action of seizing and excavating a large stone to a considerable extent, gives rise to a great number of important considerations, and it is incredible how much an addition of a single line in a calculus exceeding twelve lines in diameter, increases and multiplies the difficulties.

In fact, large stones being placed in contracted bladders, both relatively to the size of the stone, and absolutely, from the thickening of the parietes of the organ, it follows that an instrument destined

to grasp these calculi must be constructed, so that, with a small projection of the branches from the tube, they may expand sufficiently to encircle the stone; the instruments with three branches do not possess this property, but require, in order to present sufficient expansion, that a considerable projection should be given to the forceps, and even then, large stones being placed near the neck, are removed from the part where they most widely expand.

The larger a stone is, the more difficult it is to maintain immoveable in the forceps; especially with the three-branched instruments, the branches of which, belonging to the same tube, are drawn down simultaneously upon the calculus, so that the three claws scarcely ever take firm hold on its surface; in general only two grasp the stone, and sometimes only one; the calculus is, consequently, not held with that solidity so indispensably necessary for allowing the excavators to act with sufficient energy.

The larger a stone is, the greater is the quantity of powder produced; it was consequently necessary to devise suitable means for washing it away as fast as it accumulated; for although of little importance when resulting from the excavation of a stone of an inch in diameter, it becomes a more serious consideration in proportion as the quantity of powder increases; for the water soon becomes saturated, and impedes the manœuvres.

A large stone being unfavourably situated near the neck of the bladder for being grasped, it was also necessary to devise the means of displacing it from this part of the organ, so as to make it correspond to the widest expansion of the open forceps, and render its seizure easy, and free from forcible movements. In large bladders we may produce this effect by elevating the pelvis to a considerable degree, but in cases of small contracted bladders, we must employ mechanical means.

The action of the instruments must be more efficient in proportion as the stone increases in size; and this, in a great measure, depends upon the manner in which it is seized; for the excavators will find more substance to act upon, the nearer their action commences to the centre of the calculus; it was therefore of the utmost necessity to lay down precise rules for seizing and maintaining voluminous stones; it was also important to regulate this action, and to unite all those means likely to render its performance successful, since on this principally depended the success of excavating and breaking such calculi; it was necessary to discover the means of hollowing out the stone sufficiently to facilitate the action of breaking it—which result, the limited resources, and the imperfect action of the three-branched instruments, prevented us from obtaining.

In the construction of the combination called

"évideur à forceps," which differs materially from the instruments already examined, both with respect to those parts of it destined to seize the stone, and those destined to destroy it, we have accomplished all that was prescribed as being wanting to an instrument intended to act on large stones. We will not say any more to prove the importance of the motives which induced us to construct this new system of destroying vesical calculi; having stated the most general and important, we leave the discovery of the secondary inducements to the good sense and reasoning of the reader, who by examining and studying this combination will be adequate to the task.

Construction of the Apparatus "Evideur à Forceps."

General Idea. (See plate 2nd.)—We have called this combination *apparatus*, because it does not consist of a single instrument uniting in itself the properties necessary for seizing and destroying the calculus, but because it is composed of a series of instruments, some of which are destined to seize the stone, and others which serve to break it; in this respect the disposition of its component parts bears no resemblance to the "perce-pierre," and "trois-branches à virgule," which unite in themselves the properties of grasping and breaking.

In the "évideur à forceps" therefore, we shall find several distinct and separate instruments—those which are employed for seizing and maintain-

ing the stone, and those destined to destroy it. Two instruments are employed for seizing and maintaining: which are, 1st, the "pince maîtresse, ou pince à forceps"—chief or principal forceps (pl. 2. figs. 1 and 11); the second is a delicate forceps, destined to assist the "pince maîtresse," and is called "pince servante"—assistant-forceps (figs. 8. 10. 11). Three are employed for destroying: which are, 1st, a *perforator* (figs. 13, 14, 15); 2d, an *excavator* (figs. 16, 17); and, 3d, a "*percuteur*"—percussion-rod (figs. 18, 19). The two first denote their action; the third strikes the stone when it is reduced to the form of a shell in order to break it.

This apparatus being composed of so many different parts, might induce us to think it more difficult to manœuvre than the other instruments. This would be an erroneous conclusion; for each part being constructed to perform a single act, the manœuvres necessary for its accomplishment cannot possibly be confounded with, or impeded by, those necessary for performing any other. We may from this infer, that the apparatus "évideur à forceps" is on the contrary more simple and easy in its manœuvres than any of the other instruments; in fact, with the latter all the movements are combined and united to obtain a definitive result; and when this is the case, there must be less simplicity. We are deviating from our subject; but we will allow the remark to remain, since it throws light upon the subject. In

pursuance of our first plan, we will begin by giving a general idea of the instruments which compose the apparatus "évideur à forceps;" after which we will explain their construction, their mechanism, and their action on calculi.

Construction of the "Pince-maîtresse," or "Pince à Forceps."

General Idea.—This instrument, represented (pl. 2. figs. 1 and 11,) is composed of an external and internal canula, soldered the one inside the other. The internal tube is square, and leaves between it and the external canula a space divided into four distinct passages, which receive four separate branches. These can be pushed out of, or drawn into the tube, the one after the other; or simultaneously, by means of a separate piece (fig. 3), called a "rappel" (recaller), so named from its use, being employed to *recal,* as it were, the branches altogether into the tube. This piece is a sort of box, which envelops the four little buttons placed at the extremity of the branches, and shuts by means of a catch. (The 4th and 11th figures represent the "rappel" placed on the buttons.) Three of the branches are terminated by little flat portions in the shape of hooks, and the fourth by a "capuchon" (hood). By means of this instrument, and with the assistance of the "rappel," a large round calculus may be seized and firmly secured; not by grasping it in the same manner

as the other instruments, but by encircling it first with three of the branches, and afterwards by sliding the fourth branch with the *hood* above or beneath it, as circumstances may require.

A Study on the different Parts which compose the "Pince à Forceps."

External Tube.—(Fig. 1. *a. a.*) It is about eight inches long, and generally three lines and a half in diameter. At the extra-vesical extremity, we observe a square portion (*b*), the "armure," and a sort of disk (*c*), the external "pavillon," through which there is a hole filled up by a stopple (fig. 5); this hole communicates with the space separating the external and internal tubes, and allows water to be injected into the bladder whilst the instrument is placed in the urethra.

Internal Tube.—It is square, and is soldered in the whole length of its four angles in the interior of the external tube, so as to form with it four canals, destined to receive the four branches of the instrument. (We cannot easily distinguish the internal tube in the figure, since at its vesical extremity it is concealed by the external tube, and at its extra-vesical extremity the branches and their "conducteurs," or pieces on which they play, screen it from our sight; we can, however, see a section of it in the 4th figure, at the point (*a*).) The internal canula at its vesical extremity is not carried to a level with the external canula:

there is a space of about four lines between their edges; at the other extremity of the internal tube, we observe a disk (*d*), the internal "pavillon," similar to the external "pavillon" (*c*); there is beyond this "pavillon" a sort of cap (*e*), which is screwed to the end of the internal tube, and keeps the "conducteurs" (*i. i. i.*) of the branches in their respective places. In this cover there is a canal, which may be stopped up at will by the stopple (fig. 2), and which communicates with the central canal of the instrument.

On the Branches.—They are four in number, separate, and are placed in the four passages existing between the two canula. Three of them are terminated by flattened extremities in the shape of hooks; the other presents a sort of "capuchon" (hood), which forms the end of the instrument when it is closed, and is a sort of claw adapted to take firm hold on the stone when it is seized (the 6th, 7th, 11th, 20th, and 21st figures give us an idea of the four branches). The extra-vesical extremities of the branches are fastened by means of two small notches in each, to four little *cases* (*p. p. p.* fig. 1st), which are traversed by four thin steel *bars* (*i. i. i.*), along which these cases slide. These bars are placed between the external and internal "pavillons," and guide or direct the cases fixed to the end of each branch, from whence they are called "conducteurs" (conductors). To each *case* appertains a wide-headed screw (*k. k. k.*),

which, when turned down upon the *conductors*, render the branches immoveable. The head of each screw presents two little holes, corresponding exactly to two little projecting points, placed on a sort of turnscrew, by means of which the branches may be rendered moveable or fixed. This piece is drawn among the accessory instruments (pl. 4. fig. 8).

On the "Rappel."

General Idea.—(Pl. 2. fig. 3). Although this may appear a separate piece, it must, however, be considered as forming a part with the "pince à forceps;" for without it this instrument could not perform what it was intended to accomplish. In fact, it is only by means of the "rappel" that the branches, otherwise only moveable separately, can be moved simultaneously. Let us proceed to examine this piece.

Construction of the "Rappel."

It is a sort of round, flattened metal box, which opens at about the middle of its longest diameter. When shut, it resembles a watch (fig. 4); when open (fig. 3), we observe a circular cavity, adapted to comprise the cases (*p. p. p.*), fastened to the end of the branches, and the buttons (*k. k. k.*); it shuts by means of a catch (*a*), and opens when we press upon the button (*b*), by means of the spring (c). We observe, at (*d. d. d.*), semi-circular openings, forming, when the piece is closed, a

round hole of six or seven lines in diameter, which has for object to allow the "rappel" to be shut without being prevented by the body of the instrument (fig. 4). At the point *(f)*, there is also an opening but of a different shape, and which is so constructed as to admit of the case and button of the "branche à capuchon" passing out, as is seen (fig. 11,) and as will be more clearly understood after studying the mechanism of the "rappel," combined with that of the "pince à forceps."

Combined Mechanism of the "Pince à Forceps," and of the "Rappel."

When the "pince à forceps" is closed (fig. 1), the little cases fixed to the branches are on a level, and are near the internal "pavillon" (*d*). Each branch is drawn into its respective canal. The three terminating in claws are concealed by the external tube, in the interior of which they are placed, one above another. The *hood* of the fourth branch is alone visible, and forms the end of the instrument; it is round on one side (fig. 7), and hollowed out on the other (fig. 6).

If we make one of the little *cases* slide along the *conductor* which directs it, towards the external "pavillon" (*c.* fig. 1), we make the corresponding branch project from the tube; if, on the contrary, we draw the same *case* towards the internal "pavillon," we bring the branch back into its sheath. Although the branches may be moved separately, we shall see hereafter that there is a

certain order in which they must be pushed out of, or drawn into the tube. If we make the four project, one by one, to any distance exceeding an inch, and bring back the "branche à capuchon," it will place itself between the two lateral branches, which it will support and expand (fig. 11).

Although the "capuchon", when drawn towards the tube, seems to cover the opening of the internal canula, it does not, however, prevent straight rods from being introduced through the instrument, and appearing between the expanded branches (fig. 11).

The expansion of the two lateral branches, when the "capuchon" is drawn down between them, is as wide as it possibly can be; for, if we observe, the extremities of these two branches would correspond to the two extreme points of the diameter of a circle described from the axis of the instrument as centre, and the circumference of which would pass by the hooks of the four branches.

When the "rappel" is made use of, it must be placed so as to encircle the four little cases and buttons. The opening (*f.* fig. 3) must correspond to the button of the branch "à capuchon," and must be turned towards the internal "pavillon" (as is seen, figs. 4 and 11.)

By making the "rappel" advance towards the external "pavillon," the branches project equally and simultaneously from the tube. When they pro-

ject about an inch, the *hooded branch* ceases to be propelled by the "rappel," and remains behind by passing out at the hole (*f.* fig.3). If we draw the case of this branch towards the internal "pavillon," the "capuchon," by coming between the two lateral branches, supports and expands them. (See fig. 11.) We will afterwards shew the importance of this property.—When the branch "à capuchon" is thus drawn between the two lateral branches, the forceps may be made to expand more or less, as circumstances may require, by moving the "rappel" nearer to, or further from the external "pavillon." If we wish to close the instrument, we must first push the case of the *hooded branch* inside the "rappel" through the hole (*f*), which let it out, and then draw them all four together towards the internal "pavillon." We can also close the instrument by first detaching the "rappel," and afterwards drawing the branches into the tube separately, beginning by the branch opposite the "capuchon;" then by the one on its right; afterwards by the one on its left; and, last of all, by the branch "à capuchon" itself. To understand what I mean by right and left, it is necessary to know that the "capuchon" must be directed upwards, and the "pavillons" must be turned towards the body of the person who is manœuvring.

Having explained the construction and mechanism of the "pince à forceps," let us proceed to consider the "pince servante."

On the "Pince-servante."

General Idea.—(See figs. 8, 10, 11, and 12.)—It is a long thin forceps consisting of three branches, which are projected from, or drawn into the tube by means of three rings, suitably disposed for allowing the forceps to be manœuvred with one hand. This little instrument enables the surgeon to acquire exact notions on the position of a stone, assists the "pince-maîtresse" in seizing it, and places it centrally between the branches; the "pince-servante" is, however, more particularly destined to ascertain where a calculus is placed, and to remove it from the neck of the bladder; it assumes, therefore, according to the object for which it is employed, the different names of—"pince-servante," when it assists the principal forceps to secure the stone; "indicateur," when it indicates the position of this body, and "repoussoir," when it pushes the calculus from the neck of the bladder to make it correspond to the widest expansion of the "pince-maîtresse."

Construction of the "Pince-servante."

It consists of a long thin tube (fig. 8, *a. b. c.*) containing a metallic wire, which terminates at its vesical extremity in three branches, expanding by their elasticity, and, with the exception of the claws, perfectly analogous to the three-branched

forceps already defined; two rings (*dd*) joined together, are screwed to the end of this wire; these rings slide along two openings found at the sides of the tube (*ee*), which is a continuation of the long tube forming the body of the instrument, only of a larger diameter. Another ring (*g*) is screwed to the extremity of the tube (*ee*).

A separate piece (Fig. 8. *hi.*) is annexed to the "pince-servante." It is a little box constructed to receive a cork in the portion (*i*); a central hole is made in this cork through which the tube of the small forceps plays with facility, without allowing the water to escape between the central canal of the principal forceps and this tube. I have called this piece "bouchon curseur" (moveable stopple), from its use; the portion (*h*) fills up the canal of the principal forceps in the same manner as the stopple (fig. 2.).

Mechanism of the "Pince-servante."

When the branches are closed (fig. 8.) they unite together, and form an extremity in the shape of an elongated olive (fig. 9 represents the closed forceps in natural size); the rings (*dd*) are drawn near the ring (*g*). When the branches are expanded (fig. 10), they project about an inch and a half from the tube (see fig. 12, which also shews the expanded forceps in its natural size); the rings (*dd*, fig. 10) are removed from the ring (*g*); thus in order to open and shut the

"pince" alternately, it is necessary to move the rings (*dd*) further from, or nearer to the ring (*g*); to manœuvre the little forceps with ease, the thumb must seize the ring (*g*), and the fore and middle fingers the rings (*dd*).

Combined Mechanism of the "Pince à Forceps" and "Pince-servante."

The "pince-servante" being destined to assist the "pince maîtresse" in seizing the stone, must, while this is being performed, be in certain and given relations to the principal forceps; these relations I will briefly point out at present, and will reserve a longer and more detailed account for another chapter, when treating on the manœuvres.

When we endeavour to seize a stone with the "pince à forceps," the "servante," with the branches closed, must be introduced into the central tube of the "pince maîtresse," of which the "bouchon curseur" stops up the canal; (see fig. 11,) in this manner the little forceps can play with facility in the tube of the instrument, without allowing a drop of water to escape.

It follows, therefore, that when the principal "pince" is expanded in the bladder, the "servante" can explore, and discover whatever is before the branches. (The 11th figure conveys an idea of what I am trying to explain, but which will be rendered still clearer when we bring the instru-

ments into contact with calculi, and, above all, when we treat on the operation.)

Let us now examine those parts of the "évideur à forceps," which serve to destroy the stone, and which consist, as we already know, of a *perforator*, an *excavator*, and a *percussion rod*.

On the "Perforateur."

General Idea.—(Figs. 13, 14, 15.)—It is a long steel tube containing a central wire, destined to make a little *blade* project, (as is represented in the 15th figure in natural size,) by means of a piece of mechanism placed at the extra-vesical extremity of the instrument. The possibility of causing the projection and drawing in of this *blade* is rendered absolutely necessary from the small size of the tube through which the *perforator* must pass; for this tube being only about two lines and a half in diameter, requires that the little *blade* should be drawn into its mortise, when the *perforator* is introduced into, or withdrawn from the instrument, and that it should be expanded when it is made to act upon the stone.

Construction of the "Perforateur."

(See fig. 13.)—It is a long thin tube, but of considerable force, which contains a wire. On one side of the vesical extremity of this tube, there exists an opening through which a little *blade*, attached to the corresponding end of the

central wire, projects by means of a propulsive movement communicated to this wire; the extremity of the little *blade* terminates in a sharp point, suitably disposed to form with the end of the tube, which is itself pointed and beveled on three sides, a sort of drill: the action of the *perforator*, when rotated by the bow, is by this construction rendered very energetic, and forms in the stone, when the *blade* is fully projected from the tube, a hole of three lines and a half or four lines. (The extremity of the perforator with the *blade* drawn into the tube, is represented fig. 14, in natural size, and in the 15th the blade is projected.)

Having studied and explained the vesical extremity, we will now direct our attention to the extra-vesical extremity.

The "monture" of the *perforator* consists of a tube (*c. d. e.* fig. 13.), hollow from (*c*) to (*d*), and solid from (*d*) to (*e*); in the hollow portion there is a moveable piece of steel screwed to the extremity of the central wire; this piece presents two inclined planes, one corresponding to the screw (*h*), the other to the screw (*g*), which by their pressure move the rod, and consequently the wire to which it is fixed. The plane corresponding to (*g*) being so sloped, that in proportion as this screw presses upon it, the wire is propelled towards the vesical extremity, and the screw on the other side having for effect to make the wire

move in a contrary direction; it follows that this central wire is made to advance or recede according as the pressure proceeds from the screw (*g*) or (*h*). At the extremity (*e*) of the *perforator*, there is a moveable top similar to the one at the end of the "mandrin à virgule." Lastly, we observe a pulley (*k*), which can be either rendered fixed or moveable by fastening or loosening the screw placed on a portion of tube attached to the pulley. These are the different pieces which enter into the formation of the *perforator*.

Mechanism of the "Perforateur."

When the *perforator* is closed, the little *blade* fixed to the central wire is drawn into the mortise destined to receive it (fig. 13). The screw (*h*) is turned down as far as it will go—that is, till its extremity has reached the bottom of the inclined plane. When the *perforator* is open, the little blade projects from the mortise, as is seen in the (15th figure). The screw (*h*) is unfastened, the other screw (*g*) is screwed down as far as possible, and its extremity has arrived at the bottom of the slope destined to make the wire advance, and consequently to force the *blade* to protrude.

On the "Evideur."

General Idea.—(16th and 17th figures.)—Like the *perforator*, it consists of a long tube, contain-

ing a central wire; not, however, destined to produce the projection of a small *blade*, but having the power of communicating to a *blade*, the extremity and one side of which are armed with teeth—a movement by which it gradually inclines, and recedes from the axis of the instrument. By means of this mechanism, the " évideur," when rotated by a drill-bow, produces an eccentric action in a stone, and excavates it.

Construction of the " Evideur."

All the parts of this instrument, with the exception of the vesical extremity, are absolutely similar to those of the *perforator*. The inclination of the *blade* is equally produced by means of screws, which make a steel wire advance or recede by pressing upon two inclined planes. We, therefore, observe, in the construction of this instrument, the tube (*c. d.* fig. 16), which contains the piece of steel presenting the inclined planes, the two screws (*h* and *g*), the moveable capital (*e*), and the pulley (*k*). The only difference is, that the blade (*o*)—represented in half-nature (fig. 16,) and as large as nature (fig. 17)—is differently constructed. It will, therefore, be necessary to enter into a more minute explanation.

This *blade* is jointed to the tube (*a. b.* fig. 16) by means of a strong bolt, and presents, at the extremity nearest the " monture," a mortise, in which is fixed the end of the central wire by means of a

similar articulation. The combined action of these two joints is to incline or straighten the blade.

This *blade* is constructed so as to work efficiently on the stone, and presents, when it is inclined, a double row of teeth on its external side, and at its extremity a sort of "crête de coq" (cock's-comb), of which the projecting points are placed in the most favourable direction, and according to the most appropriate rules for allowing it to cut into the stone during its rotatory movement. This movement will be described when we are studying the action of this instrument on calculi.

Mechanism of the "Evideur."

The mechanism is absolutely similar to that of the *perforator*. By turning the screw (*g*. fig. 16), after unscrewing (*h*), the central rod is made to advance, which causes the *blade* to incline: by turning the screw (*h*), after unscrewing (*g*), we produce the contrary effect. When the blade is inclined to its full extent, its extremity is about an inch from the axis of the instrument, which gives it an eccentric action, capable of producing in a stone an excavation of two inches. The extent of this excavation varies, however, according to the length of the *blade*, which is itself longer in proportion to the size of the stone.

A given relation must invariably exist between the "évideur" and the "perforateur." They must be exactly of the same length, from the point (*b*)

of each instrument to the pointed extremity of the perforator, and to the " crête de coq" of the excavator.

On the " Percuteur."

General Idea.—It is a simple steel rod (fig. 18), destined to communicate a shock to the bottom of the shell, resulting from the action of the *excavator,* and which, as we shall afterwards see, is of some strength and solidity.

Construction of the " Percuteur."

From *a* to *b*, (fig. 18.) it is solid, quite straight, and smooth. The extremity (*a*) is cut flat, and is rough, without being denticulated. The end (*b*) terminates in a ball of silver (*c*) filled with lead, in order to give more weight to the instrument. A "curseur" (runner) (*d*), which by means of a screw can be fixed on any point of the rod, constitutes the "percuteur."

Mechanism of the " Percuteur."

This instrument, acting in mass, cannot, properly speaking, be said to consist of any mechanism, which generally implies one part playing upon another; the only thing to be remarked is, that the "curseur" stops the course of the instrument, and only allows it to penetrate into the central canal of the principal forceps, far enough to strike the shell of the stone with sufficient power to reduce it into frag-

ments, without, however, going so far through the tube as might prove hurtful.

On the Action of the Apparatus "Evideur à Forceps" on Calculi.

We must examine this action under two different lights, that of seizing a spherical calculus of from 14 to 24 lines in diameter, and that of excavating it.

On the Action of Seizing.

This action is not simple, as with the three-branched instruments, with which we seize the stone, by seeking to bring it between two expanded branches in the same manner as we should try to grasp a piece of coal with a pair of tongs. The principal disadvantage of these instruments is, that there is only, between the two lateral branches which are to seize the stone, an expansion equivalent to the third of a circumference. This defect is remedied in the "évideur à forceps," which presents an expansion of half a circumference to encircle the calculus, for although consisting of four branches, the one with a "capuchon" being withdrawn between the two lateral ones corresponding to it, while the stone is being seized, leaves a space equal to half a circumference.

It follows, therefore, that with the instrument "à forceps," assisted by the "servante," a stone

may be seized with comparative facility, and it is not necessary, in the manœuvres, to press upon the neck of the bladder, which the other instruments often render necessary. The facility of grasping the calculus is also increased by being able to slide the "branche à capuchon" as far as the other three, before they are drawn upon the stone, and so to seize it, as it were by surprise; in this manner the calculus is retained between the branches, but is at the same time moveable, and can be placed with the little forceps most conveniently for the excavators to act upon it as centrally as possible; the performance of this, as may be conceived, only requires gentle and inoffensive manœuvres.

If we consider, that besides being able to seize the stone with much greater facility, the branches of the "pince à forceps" project to a very small extent out of the tube; we shall, I think, without opposition, acknowledge the advantage this instrument possesses over the others in cases of small bladders and large calculi. In fact, the more the branches of an instrument can be made to expand, the less necessary it is to make them project far from the tube which contains them. Having considered the action of seizing, let us now proceed to examine what are the means of securing the calculus when it is once seized.

We selected as one of the defects of the three-branched instruments, that they did not maintain

the stone firmly, and we discovered that this fault depended principally upon the branches being drawn down upon the calculus simultaneously, which prevented the hooks of each one from taking firm hold. The "pince à forceps," by its construction, remedies this serious defect. The four branches are first drawn simultaneously upon the calculus by means of the "rappel," in the same manner as those of the other instruments; but by afterwards taking off the "rappel," and by drawing down, two by two, first the branches on each side of the branch "à capuchon," and then the two others, the four hooked extremities of the branches must necessarily rest upon the stone, which, however irregular, finds in them sufficient support: the calculus is then rendered immoveable, by fastening each of the screws (*k. k. k.* fig. 1.) on the *directors* (*i. i. i.*) of the branches. When a stone is thus seized by the "pince à forceps," it is held firmly rather by the manner in which it is seized and secured by the branches, than by the force of the metal; with the three-branched instruments, on the contrary, the maintaining of the stone is only obtained by means of great pressure, which is attended with many inconveniences.

Two advantages result from seizing the stone in this manner; the first is the possibility of being able to appreciate its size, the second, of forming an idea of its shape. For, when the four branches are drawn down together by the "rappel," the degree to which

it can be brought forward indicates approximatively the size of the calculus; the nearer it remains to the external "pavillon" the larger the stone is. We may also, by successively drawing down the four branches, two by two upon the stone, obtain exact notions on its irregularity, for the little cases fixed to the extra-vesical extremity of the branches approach nearer to the internal "pavillon," according to the degree of depression in that part of the calculus on which they are drawn. When the cases are nearly on a level, it denotes that the calculus is nearly spherical, for the four branches rest on its circumference at about the same height. Another important consideration appertaining to the action of seizing, is the great facility with which the stone can be let loose from the "pince à forceps," when circumstances require it; this facility is an additional proof of the advantage and importance of this combination, and is owing to the valuable property of being able to move the branches separately. The three-branched instruments are exceedingly defective in this respect, for when a large stone is seized in a small bladder, it is always with the greatest possible difficulty that the instrument can loose it; the "évideur," on the contrary, can perform this very readily, for by simply shortening two of the branches placed together, and lengthening the other two, it is evident that the points which support the stone will not be opposite each

other, and it can no longer be maintained by the forceps. This advantage is consequently entirely dependant upon the separate mobility of the branches.

On the Action of Excavating and Breaking.

This action is performed by means of the three separate instruments, known already by the names of "perforateur," "évideur," and "percuteur."

We may, by making the little *blade* project from the *perforator*, give it the appearance of a *borer*, and produce a hole of three and-a-half lines, or four lines, in the centre of a calculus. This perforation, which may be called the first "temps," or *steps* towards excavating, must penetrate far enough into the stone to allow the "evideur" to hollow out two-thirds of its antero-posterior diameter. So that in a calculus of twelve lines in diameter, the hole must be nine lines in depth; in one of sixteen lines, it must be twelve lines in depth, and in one of twenty-four, eighteen lines.

After having first perforated the stone, the "évideur" may, by being introduced into the hole, act in the interior of the calculus. The action of the "évideur" is two-fold: *the time for excavating*, and *the time for retreating*. The first of these does not consist, like the "virgule," in merely inclining a little *blade*, and producing, by a rotatory movement, a conical excavation in a stone; it

more complicated ; for, on account of the size of the calculus, different manœuvres, and greater resources are required, to reduce it to a thin shell, and render it friable.

If we wish to comminute a stone of ten or twelve lines in diameter with the "évideur à virgule," it is not at all necessary to reduce much of its substance to powder; for being small, it is easily broken into fragments by means of the movement of *retreat*, which takes place when the circular action of the "virgule" is completed, and the broken portions are crushed with another instrument, of which I shall make mention hereafter. But if this action were applied to a calculus of eighteen or twenty lines in diameter, it would be very ineffectual, for the fragments would be large and numerous, and quite out of proportion to the power of the instruments destined to destroy them ; thus we see that the larger a stone is, the more of it must be brought away in powder, and more care must be taken to give the fragments a shape and thickness the most favourable to their easy reduction into smaller pieces. We shall know the value of the combination "évideur à forceps," and perceive its importance, when we come to consider that its mechanism causing it to act from the centre of a stone to its circumference, enables the *excavator* to produce a larger quantity of powder in direct proportion to the volume of

the calculus. Let us examine the action of the "évideur."

This instrument replaces the *perforator* when it has penetrated into the three-fourths of the thickness of a stone, and acts upon the sides of the hole with the "crête de coq," already mentioned; the teeth of which do not scrape the stone, as it were, but cut off thin flakes by means of a particular movement given to the drill-bow. These teeth are placed in such a manner, that in proportion as the *blade* is inclined, they act successively upon the stone. When it forms an angle of 15°, the inferior tooth acts most efficiently; at 30°, the middle one works principally on the stone, and at 45° the destruction is obtained by means of the tooth, quite at the extremity of the blade. If we examine the direction given to the teeth, we shall find that they are not destined to act upon the sides of the hole by a simple rotatory movement, but that this movement is combined with a peculiar impulse given to the *excavator* by means of the bow, which makes it advance from the opening of the hole to the posterior part, in such a manner that the teeth of the "crête de coq" biting in the groove formed by the preceding stroke of the bow, not only detach powder from the calculus, but a sort of fine gravel, or thin flakes, resulting from the section produced by this movement. Long practice, and gentle manœuvres, are

absolutely necessary in the employment of this instrument; force must be entirely rejected as injurious, since it would prevent the excavation from being performed with sufficient regularity and nicety; when acting upon the hardest stones, it ought hardly to be perceptible that any thing impedes the progress of the "évideur."

This action will be more perfectly and correctly understood by those persons who have handled mechanical instruments which work by *progressive wearing away*, such as a plane or a saw; in the same manner, the "évideur à forceps," and its component parts, destined to destroy the stone, may, without being overcharged with metal, be constructed so as to excavate voluminous calculi.

Having explained the manner in which this instrument acts, let us proceed to consider what rules must be laid down, and what indications are to be attended to, in order that it should act with safety and product.

To render the action of the instrument *productive*, a large portion of the stone must be brought away in powder; to perform it with *safety*, the action of destroying must take place in the interior of the stone, which prescribes the necessity of leaving all the exterior untouched.

If we reflect on these two indications they appear almost to contradict each other, for the more of the stone is reduced to powder, the less atten-

tion is paid to leave the outside entire, and *vice versâ*, the greater the portion of stone you leave untouched, the smaller will be the quantity of powder produced. We must, therefore, in order to place exact limits to the action of the instrument, lay down the following rules.

The stone must, as we said before, be perforated only as far as the three-quarters of its diameter; if we make the "évideur" play in this hole, there can be no danger of its coming in contact with the posterior part of the bladder, between which, and the *excavator*, there is a mass of stone of some thickness; if, on the other side, we leave that quarter of the diameter of the stone corresponding to the hole through which the *perforator* entered, untouched by the *excavator*, the result will be that the posterior and anterior parts of the bladder will be in perfect security, since they will both be protected by a solid mass of stone, and the excavation in the interior of the calculus will be almost cylindrical, and in the two middle quarters of the antero-posterior diameter. The portion of stone left untouched at the entrance of the perforation, also has the advantage of preventing the excavator from being withdrawn during its action, and stopping against the branches of the instrument.

Thus in a calculus of twelve lines in diameter the "évideur" produces an almost cylindrical excavation of six lines, in one of sixteen lines an

excavation of eight, and in one of twenty-four lines one of twelve.*

We say an *almost* cylindrical excavation, for if we examine the action of the "évideur" on the stone, in proportion as the blade inclines, we shall find that the posterior part of the calculus assumes a vaulted appearance, and the anterior portion is something in the shape of a *funnel*.

Having discovered the means of destroying the interior of a large stone with perfect safety for the anterior and posterior parts of the bladder, since the *wall* of stone which separates them from the instruments is thicker in proportion to the size of the calculus, let us now see what are the means of security laterally.

It is evident that in certain irregular calculi, that part of them which is most depressed, and is nearest the centre, will soonest give way, and will present what I shall hereafter call a "fenêtre" (window). Well, this *window*, or opening, will either be small, and not allow the "évideur" to project sufficiently to prove injurious, or else it will be to a considerable extent, and the teeth

---

* Although we ourselves, from long practice, and a thorough knowledge of our instruments, carry the excavation of a calculus much nearer its two extremities, we however strongly recommend a beginner in this operation to follow the directions here laid down, and to leave untouched a quarter of the stone's diameter, both posteriorly and anteriorly.

of the *excavator*, by entangling in one of the corners, will cease to turn. This circumstance is a sure indication that the *movement of retreat* must be made; or rather, it indicates that the *excavator* must no longer be made to act at the bottom of the hole made primitively by the *perforator*.

This *retreat*, by preventing the teeth of the "crête de coq" from coming in relation with the opening, prevents the *blade* from being stopped in its course, and it continues to act upon another part of the stone; in the same manner as before, another portion of the calculus, which approaches the nearest to the centre is so much reduced, that it gives way and forms a second "fenêtre;" this opening generally is on the same side as the former one, since it is mostly formed in the same depression; it is a favourable circumstance for the two openings to be on opposite sides, for this denotes a greater degree of sphericity in the calculus, and shews that the excavation is more regular, and has produced a more perfect shell.

When one or two openings are made in the stone, which are usually found near the diameter, at right angles with the axis of the instrument, then we must terminate the *movement of retreat*, in the same manner as we performed the *retreat* of the "virgule," which we are already acquainted with.

This movement is destined to destroy, by means of the teeth placed at the exterior of the blade,

that part of the stone nearest the operator which was left untouched when the excavation was begun.

This portion of the calculus being something in the shape of a funnel, is easily destroyed by the external teeth of the "évideur," if during its rotation we draw it towards the opening of the hole; when the instrument has acted some time, and has taken the greater part of the substance away in powder, the stone gives way at one or the other side, and forms a large opening, into which the excavator enters, and can no longer be rotated.

Here terminates the action of the "évideur," for it has accomplished what it was intended for, namely, *having reduced to powder the largest possible portion of the calculus without coming once in contact with the parietes of the bladder.*

Such is the action of the "évideur à forceps" when the stone is sufficiently hard to sustain the attack without breaking; if it should give way before the action is completed it is less favourable, for there is not so large a quantity of powder produced; the end of having broken the stone would, however, be obtained in both cases. When the fracture of the stone takes place, the "évideur" is immediately prevented from proceeding in its rotatory movement, either by meeting with the branches of the instrument, or else by becoming entangled in the fragments of calculus which

remain in the forceps, so that the parietes of the bladder cannot possibly sustain any injury, even if they were not distended with water, which is never the case, for a fresh injection can always be made through the instrument without withdrawing it.

When the stone is hard enough to remain entire after being excavated, it remains in the forceps in the form of a shell, firmly maintained by the four flattened extremities terminating the branches; this shell is very thin, excepting at the posterior part, where it forms a sort of *dome*, and has been left, according to the rules, of the thickness of a quarter of the stone's diameter; it is to break this dome that is destined the "percuteur."

With this instrument, which is nothing more than a simple steel rod cut flat at one end, and having a piece of lead at the other, we may communicate a powerful shock to the posterior part of the calculus. In order to perform this, we must first make the "percuteur" reach as far as the bottom of the shell, and then fix the "curseur" two or three lines higher up, so that the blow may be more forcible, and penetrate two or three lines into the thickness of the shell, by which means it will be broken at once, whatever be its hardness, without the bladder being exposed to the slightest injury, since the "curseur" stops the force of the instrument, and only allows it to go a given distance.

Such is the action of the series of instruments which complete the apparatus "évideur à forceps;" we will, when treating on the manœuvres, explain what are the means of performing them with *mathematical certainty*. The idea which we have already given is sufficiently exact for enabling our readers to perceive the motives which induced us to construct this apparatus, and for rendering them competent to understand the details, which combine to form a system, by means of which we are able, *in one single "séance" in one attack, and by only once seizing the stone*, to do more towards restoring to health a patient having a large spherical calculus, than could be performed by the "perce-pierre" in a great number of long and painful operations. The mere inspection of the (figures 22, 23, plate 2,) representing the two portions of a large, excavated calculus, will clearly evince the immense advantages of this apparatus in such cases. When this system is employed, the greater part of the stone is voided in powder with the greatest ease, which saves the patient the fatigue and pain of passing many fragments; the application of the system is also advantageous in as much as it leaves the calculus which remains in the bladder in the most favourable state for being easily and rapidly destroyed by the instruments acting by percussion or by crushing. In fact, if the shell should remain entire, or nearly so, after the action of the

"*percuteur,*" it may be easily broken with an instrument which communicates to the stone the blow of a hammer; this produces flattened, concave fragments, which are seized and destroyed with difficulty by the "perce-pierre," but are in perfect relation to the power and disposition of the instrument to which we will now direct our attention.

ON THE

BRISE-COQUE.

Motive for which this Instrument was constructed.

If, with the instruments we have been examining, we seek to comminute the fragments resulting from the action of these instruments, we shall find that the portions of calculus they produce must evidently be very unfavourable to the action of the "évideurs," whether the "évideur à forceps," or the "trois-branches à virgule:" for the idea associated with the word *excavation*, is, that the substance to be acted upon should present diameters of nearly equal dimensions, and as soon as the diameters of any body differ very considerably, we immediately conclude that *excavation* is not applicable, since there is not sufficient substance to be excavated. There only remains, therefore, to destroy these flat and concave fragments, the "perce-pierre," which might possibly reduce them into smaller pieces; but if, on the other hand, we put this instrument to the test, and try to comminute such fragments, we shall soon find that we must

often be deceived in its action, which is too frequently quite ineffectual, or nearly so. The greatest inconvenience with such fragments is, that the "perce-pierre" almost always grasps them badly. The flatness of the body, when seized, allowing the branches to approach very near together, presents an obstacle to the free play of the perforator, which in most cases is absolutely prevented from turning; but if by chance it can be rotated, the fragment being badly seized and maintained generally by only two of the branches, escapes at the first movement of the drill-bow: if, instead of using the bow, we wish to crush a fragment by the mere pressure of the drill, the piece of stone most frequently slips between the two branches by which it is unsteadily maintained, or escapes by expanding the hooks which seldom grasp it firmly; should we seek to pulverize a fragment by the pressure of the branches, we find that they are wanting in power when the instrument is small, and that when there is a sufficient quantity of metal to prevent them from yielding, the manner in which the fragment is seized is so exceedingly unfavourable to this action, that it produces a very unsatisfactory and trifling result: for the most part the drill head being forced into the sort of *infundibulum* formed by the branches, presents an obstacle to their being sufficiently closed to press, with any degree of force, upon a flat portion of calculus. We may therefore safely

conclude that this instrument is badly adapted to the comminution of these fragments.

If we have proved the insufficiency of the "perce-pierre" with regard to flat fragments, we shall also have to shew how much more defective it is, as well as the "évideurs," in the destruction of flat entire calculi, for the most part smooth and polished. A concave fragment is occasionally seized well or badly, and, on account of its asperities and irregularities, it is more likely to be maintained by the instrument more or less firmly; but to seize a smooth flat calculus, is really so exceedingly difficult for the "perce-pierre," and so totally opposed to its *capacities*, that in order to prove our assertion, we think it quite sufficient to refer the matter to a trial, and only desire that the instrument should be placed in relation to a flat calculus; it will then be seen how clumsy and inefficient it is under such circumstances, and it will also be a matter of astonishment to every one, that any person should assert that lithotrity required *no auxiliaries*, when its power and resources consisted solely in an instrument as defective as the "perce-pierre." Let this instrument be employed to destroy a flat calculus, and we shall find that a patient is seldom completely restored to health in these cases, and never is without undergoing numerous attempts too frequently unsuccessful and always painful.

If, after having considered the "perce-pierre"

in this unfavourable light, we reflect on the numerous cases in which we shall have to destroy flat concave fragments produced by the excavators, and fragments of all shapes on which the action of this instrument is too often tedious and defective; if we also bear in mind the large proportion of flat stones, we shall certainly more readily appreciate the vast importance of establishing a new system for destroying these stones and fragments, which to a powerful and energetic action for crushing, should add promptness and delicacy in the manœuvres.

This end could only be obtained by means of a combination which should be made to perform, as it were, at the same time, *the action of seizing and destroying with rapidity.* We have called this, a *system of crushing*, and have discovered the means of accomplishing, with an instrument which we have named "brise-coque" (shell-breaker) all the data which were prescribed.

The name of this new combination in some sort unites its action to that of the instruments which act progressively upon calculi, and have for their object to reduce them to the form of shells.

In the first part of this chapter we stated that the system of destruction, *by crushing*, was best adapted for allowing the action of seizing and destroying to be executed at the same moment, or nearly so, and that such a system was evidently the most advantageous and desirable, since it is by

far the most rapid in its performance.* Being persuaded of this, it is our duty to apply it as frequently as possible; for a successful result will be obtained as promptly as the means are rapid and efficient.

The system of crushing is applicable whenever the calculi or fragments assume a flattened shape, or, to speak more generally, whenever they present small diameters; for we shall hereafter see that, in cases of numerous small calculi, more or less spherical, it can be employed with great advantage.

Let us now more closely study an instrument with which we are enabled to come to such important results.

Construction of the "Brise-coque."

General Idea.—This instrument, represented in different positions (pl. 3d), differs totally in its appearance from those which we have previously examined. It is a simple pair of forceps, the different parts of which are combined so as to endow it with a power of attrition sufficiently great to crush the hardest calculi. It is also of such force,

---

* I think it right to remark, that by *percussion* we can more speedily destroy a stone than by *crushing;* so that if we can devise the means of bringing the *system of percussion* into action, the "brise-coque" will be dispossessed of its superiority in cases of flat and oval calculi.

that the efforts of a man, however strong, could not break the branches, not even if he were to make them act upon a substance as hard as steel.

Notwithstanding the enormous power of this instrument, it is not loaded with so large a quantity of metal as we might be led to expect from the astonishing development of force of which it is susceptible. It has, however, the appearance of great solidity. This results from the different parts which compose it being constructed according to mechanical laws.* Notwithstanding this immense power, it is manœuvred with facility; it is opened and closed with promptness; and is delicate and clever in its movements. If it crushes the stones with *authority*, it seizes them with *agility* and *skill*.

The principal parts composing the "brise-coque" are a tube containing two very strong branches, and it is in the mechanism which forcibly draws these two branches into the tube that consists the great power of attrition of this instrument. *Spring*

* Among these laws, there are two from which we have more particularly drawn the greatest advantages. The first is, having multiplied the levers in such a manner as to obtain great power; and the second, having employed the force which results from the tenacity of the metal, rather than that resulting from its other properties of resistance. These two laws have also been particularly attended to in the construction of the "évideur à forceps" which, as we know, is exceedingly powerful without being loaded with metal.

catches, combined with *levers*, draw the branches alternately into the tube, in such a manner that a stone, or fragment of stone interposed, must necessarily be crushed.

Such is the general idea which must be formed of the "brise-coque."

A Study on the different Parts which compose the "Brise-coque."

The "brise-coque," considered in entire, constitutes a compact whole, which renders it difficult to proceed to the examination of each of its parts analytically. We shall not be able, as in the other instruments, to study successively the parts destined to seize the stone, and those adapted to destroy it; for in the "brise-coque" there exists so intimate a connection between these parts, as entirely to prohibit the possibility of separating them. This close connection results naturally from the nature of the problem we had to solve, which we expressed in the following manner:—*to unite, at the same time, as it were, the action of seizing and destroying with rapidity*."

Since we cannot do otherwise, we will study this instrument in entire, and endeavour to give a correct idea of it rather by a train of reasoning than by figures in detail, which do not come within the compass of this work.

If we examine the "brise-coque" (pl. 3. fig. 3), we observe (*a. a'*.) two expanded branches; (*b. b.*)

a steel tube which contains them; (*c. c. c.*) an oval piece, rather flattened, presenting on each side two projections (*i. i'.*), which are the handles of two springs; (*d. d.*) the external "pavillon," or a resting-place for the hand during the manœuvres; (*e. e'.*) two "montants," or square steel bars, destined to bring the branches into action; (*h*) a sort of round box, forming the internal "pavillon," in which is inclosed the joint of the handle (*g*), with the "montants" (*e. e'.*).

Such is a general idea of these different pieces, which we will afterwards consider more minutely.

We will now begin by examining the pieces which constitute the interior of the instrument. They are, the branches (*a. a'.*) which go through the whole length of the tube (*b. b.*); the "montants" (*e. e,.*), which are received in a square tube, not visible in the figure, on account of the pieces (*c. c. c.*) and (*d. d.*); the portion (*d. d.*) is fixed to this square tube, and (*c. c. c.*) is moveable on it, as we shall afterwards explain. The inferior extremities of the bars (*e. e'.*) are jointed in the interior of the square tube to the superior extremities of the branches (*a. a'.*) by means of a double mortise. This joint falls exactly at the part where the round and square tubes touch, so that the extra-vesical extremity of the branches can be drawn into the square tube; but the two bars (*e. e'.*) cannot enter into the round tube (*b. b.*).

In consequence of this, we may, by pushing the bars (*e. e'.*) as far as the round tube, make the branches expand to a given extent, and close them by withdrawing the "montants" (*e. e'.*).

We are, therefore, masters of the important property of opening and closing this instrument with *ease* and *regularity*, and will proceed to consider in what manner we obtain the expansion of the branches.

Since each branch is fastened to each of the bars (*e. e'.*), it is evident that the branches may be brought into movement by moving the corresponding bars. Well, it is by developing this property that the branches are made to expand.

In the box (*h.* fig. 3), there exists a mechanism, by means of which the handle (*g*), or *small lever* (as we shall hereafter call it), is articulated with each of the "montants" (*e. e'.*); so that, by inclining the *small lever* towards (*e*), as in the figure, the bar (*e*) is forced about a line and a half further into the interior of the instrument, and (*e'*) is drawn out in about the same proportion, the projection of the branch (*a'*) from the tube (*b. b.*) is diminished, and that of (*a*) is augmented by the alternate movements of (*a'*) and (*e'*) upon (*a*) and (*e*) in the whole length of the instrument.

If we examine the branches (*a. a'.* fig. 3.) at the spot where they enter into the tube, we shall discover two "hausses" (elevations), which, when the lever (*g*) is inclined, are brought opposite each

other, and cause the branches to diverge, and at the same time to be *maintained*, as the seventh rule requires.

It is easy to conceive that, when the lever (*g*) is not inclined, the two "hausses" do not correspond together, but are concealed in two openings made to receive them, so that the branches are partly closed, by not being supported and expanded by the "hausses," and may be entirely closed by drawing out the "montants" (*e*. *e'*.).

We have now the power, therefore, of making the branches project from the tube, of giving them a considerable degree of expansion, of supporting them, and of drawing them together. These being the properties required for grasping and maintaining a stone or fragment, we are already enabled, by means of this instrument, to accomplish this; and have only to find the means of crushing these foreign bodies when once seized.

In the first place, we can crush a portion of stone by simply compressing it between the two branches with the power of the hand only; but the force thus obtained, although sufficient to destroy soft and small fragments, is quite disproportionate to the power required for crushing a large fragment, or an entire flat calculus. We must, therefore, develop new properties in our instrument, and endow it with a much greater degree of pressure than can result from mere

manual force, which is advantageous for retaining the stone in the forceps, till the mechanism which is to crush it can be brought into play. Let us examine this mechanism.

We already know that we can, by means of the small lever (*g*), produce an alternate movement of the branches (*a. a'.*) and of the bars (*e. e'.*) on each other, and in this possibility consists the element of the great power we can give to the "brise-coque."

If we refer to the oval piece (*c. c. c.*) which is seen on its widest surface (fig. 3) and sideways (fig. 2), we remark on its sides two projections (*i. i'.* fig. 3), of an oblong shape, which are, as we before remarked, the handles of two springs, the axis of which are also placed at the sides of the piece (*c.c.c.*), and are supported by strong bolts on which they move; these springs pass through two openings made in the square tube, and play on the cogs existing on the outside of each of the bars (*e. e'.*). These cogs are arranged so as to allow the pieces (*e. e'.*) to ascend and draw the branches in the interior of the tube, but do not admit of their descent.

It follows, therefore, that the alternate movements of the "montants" (*e. e'.*) produced by the inclination of the lever (*g*), bring alternately the cogs of the "montants" (*e. e'.*) in relation with the springs; so that whilst a cog of the bar (*e'*) is resting against the spring of (*i'*), if we incline the small

lever towards (e'), the bar (e) ascends a cog higher on the spring of (i); this mechanism being repeated, shortens at each movement of the lever (g) one of the branches by a quantity which can be estimated at about one line and a half.

From this it results that the branches do not merely press upon the stone, but *press* upon it alternately in a manner similar to the action of the jaws, which differs widely from the pressure effected by drawing the branches simultaneously upon the calculus.

The piece (*c. c. c.*) being moveable on the square tube which supports it, to an extent of about two lines, we may, at will, prevent the springs from corresponding to the holes through which they pass to come in contact with the cogs, and thus give the branches as much facility of being opened or closed as if no cogs or springs existed.

It is clear that this property was indispensable, to prevent the act of *crushing* proving prejudicial to the act of *seizing*.

In a word, when the springs are not in relation with the cogs, the "brise-coque" is a delicate skilful instrument; when on the contrary the cogs act upon the springs, it assumes a different character, and becomes an instrument displaying greater power in proportion as the branches are drawn nearer together by the action of the cogs.

Now that we are acquainted with the manner in

which the different parts of the "brise-coque" are disposed to give it the power of seizing and crushing, let us proceed to examine its mechanism.

Mechanism of the "Brise-coque."

When the "brise coque" is closed (pl. 3, figures 1 & 2), the branches are drawn into the tube, and their extremity has the appearance of an olive of a regular shape, although slightly furrowed by the irregularities resulting from particular sections made in the branches, to give them the power of taking firm hold on the stone. This extremity differs little in size from the body of the instrument (the 11th and 12th figures shew the branches closed in their natural size).

The two "montants" (*e*. *e*.) which are both visible (fig. 1), and only one of which can be entirely seen (fig. 2), are drawn as far from the "pavillon" (*d. d.*) as was necessary to bring the branches into the tube up to the commencement of the olive-shaped extremity.

The small lever (*g*. fig. 1) is straight; the oval piece (*c. c. c.*) is pushed down towards the concave part of the "pavillon" (*d. d.*), and the vesical extremity of (*c. c. c.*) is not consequently in contact with the square portion (*b*) of the tube, which, although similar to the "armure" of the other instruments, is only intended to facilitate the taking to pieces or putting together again of the "brise-coque," and not to keep it firm in the

"support fixe," which with this instrument is never necessary. The handles (*i. i'.*) of the springs are drawn deeper into their respective mortises; for the springs no longer corresponding to the openings in the square tube, which bring them into contact with the cogs of the "montants," rest against the sides of this tube, which consequently forces the handles (*i. i'.*) to penetrate further into the grooves destined to receive them.

When the "brise-coque" is open (fig. 3), that is, when the branches project from the tube, and are expanded, they vary in length according to the size of the branches employed,* but the usual length is two inches and one-third, which allows them to comprise in the extent of their expansion, when they are carried to the fundus of the bladder, that portion of it where the fragments are mostly found.

When the branches are fully expanded, the

* The branches, which, in common cases are adapted to the "brise-coque," exactly resemble those of the (3, 4, 5, 8, 9, 10, 11, and 12 figs.), but under certain circumstances others are used, such, for example, as are quite flat in the inside of their extremities, others resembling spoons, for the purpose of moulding in their interior certain fragments of a soft plastic nature, which cannot be extracted without danger, by any other means; others slightly curved at their extremity, for penetrating into some bladders which will not admit of the introduction of a perfectly straight sound. In a word, the primitive construction of this instrument is susceptible of a variety of modifications, which, in the course of practice are often found necessary.

branch (a) is about three lines shorter than (a), (figs. 3 and 10); this results from the lever (g) having been inclined in order to bring the two "hausses" (elevations) opposite each other, which was effected by drawing out the "montant" (e'), corresponding to (a'), and thus shortening this branch; the two *elevations* being placed in the middle of the width of the branches, cannot possibly come into contact with the parietes of the neck of the bladder.

The inflection given externally to the branches (figs. 3 and 10), is produced by means of a loss of substance, at that portion where they enter into the tube, this portion we will hereafter call "les foibles;" this diminution in the quantity of the metal is continued to a considerable extent in the interior of the tube, so that no single part of the "foibles" produces the expansion, but it results from the loss of substance being carried to a certain length in the branches, which, without weakening too much any particular spot, produces the desired effect of making them diverge.

Although the branches expand considerably, they are almost entirely straight in their strongest portion. A small curve outwardly is, however, favourable to the crushing of entire calculi.*

* When there is an entire flat stone to destroy of considerable thickness, the branches should be curved a little externally, but for fragments they should be nearly straight.

The portion (*c.c.c.* fig. 3) retains the same position as when the branches were drawn into the tube.

The lever (*g*) is inclined towards (*e*).

When (*g*) is straightened, the "hausses" are no longer placed face to face, and the branches close considerably by the elasticity of the "foibles;" they can then be easily drawn into the tube with the hand, by withdrawing the two bars (*e. e'.*), as far as possible from the "pavillon" (*d.d.*). By these means the fragments are seized between the branches.

Having studied the mechanism of this instrument for grasping, let us now turn our attention to its mechanism for crushing.

When a stone or fragment is seized and maintained between the branches, by merely drawing them together with the hand, and when the "foibles" have entered into the tube, it is then that the "brise-coque" is converted into a powerful instrument, for then its own mechanical force is combined with that of the levers and springs; this change is effected by lowering the portion (*c. c. c.* fig. 4.), which is then brought into contact with (*b*), and the springs are in relation with the cogs of the bars (*e. e'.*).

The alternate movements of the small lever (*g*) produce the following effects; when it is inclined towards (*e*), the branch (*a'*) is shortened by a line and a half; if it is turned in the direction of (*e'*),

the branch (*a*) is drawn into the tube in the same proportion; if again we direct it towards (*e*), (*a'*) is again shortened, etc. etc., so that each oscillation of the lever (*g*) produces an alternate diminution in the projection of the branches from the tube, and consequently a proportionate increase of pressure, combined with a sort of grinding action, similar to that of the jaws, which continues till the branches are drawn completely into the tube. In cases which require a very great degree of attrition, such as for crushing a thick compact calculus, the power of the small lever is augmented by adding to it the assistance of another larger lever represented (fig. 13), which receives in the mortise (*a*) the small lever (*g*), and lengthens it.

We can easily conceive that a stone subjected to the action of such an instrument, cannot resist, but must necessarily give way; for the withdrawing of the branches into the tube is effected by the extreme power resulting from the action of numerous levers: in fact, if we take a mechanical survey of these levers, we shall find that the power of each one is, as it were, superadded to that of the others, so as to unite and determine a mass of force which unfolds itself at the extremity of the instrument.

Thus we see that the "brise-coque" unites in its properties *delicacy* and *force*, each of which is developed by the most simple manual manœuvres;

for, how are the branches made to project from the tube? by the inclinations of the lever. How are they expanded? by an inclination of the lever. How are they closed? by an inclination of the lever. Lastly, how are they drawn together so as to produce sufficient force for crushing? by the inclinations of the lever. These four divisions in operating, complete the actions of seizing and crushing, and are performed, in a few seconds, by manœuvres as gentle and inoffensive as the delicacy of the act requires, without necessitating the application of those muscular efforts which deaden in an operator the sense of feeling.

Action of the "Brise-coque" on Calculi.

The form and disposition of the branches of the "brise-coque," being exactly similar to the two branches of the three-branched instruments destined to seize a stone, it follows that calculi are as favourably situated relatively to the "brise-coque," as to the other instruments, and are seized with equal facility.

It now, therefore, only remains to examine in what manner flat calculi and fragments of stone are seized with the "brise-coque," which was invented to remedy the defective manner in which the three and four-branched instruments acted in such cases.

We will first direct our attention to the fragments, and shall readily conceive, if we examine the

interior of the branches, and the manner in which they are armed (fig. 10), that when once a fragment is grasped between two such irregular, wide and flat surfaces as these, it cannot possibly slip away, but will almost necessarily be crushed. If the fragment be of a cubical shape, and of from six to ten lines in diameter, a few movements of the lever will separate all that portion of the fragment which projects beyond the branches, from the portion which is held between them by means of the beards at (*a' a.* fig. 10) which are disposed in such a manner as to produce a section of the stone held by the forceps. It will also be admitted, without difficulty, that however far the fragment extends beyond the branches, it will be reduced to pieces in consequence of the irradiating splits resulting from the pressure; and that all the stone contained in the interior of the branches, will be ground down into powder, since, as we before remarked, the power of attrition augments in direct proportion to the shortening of the branches.

(If we turn to (fig. 9), and examine how the branches close together, we shall see that they only approach near enough to seize a fragment of two or three lines in diameter; we may consequently conclude that the membrane of the bladder cannot possibly be seized, but only the portion of stone.)

The flatter a stone is, the more difficult it is to be seized, maintained, and perforated, with the

"perce-pierre," and the more completely a stone assumes this shape, the easier it is to accomplish this with the "brise-coque" in the course of a few seconds; this property is such as will set forth the value of the "brise-coque;" its importance, however, will be better exemplified by *witnessing* the astonishing facility with which this instrument destroys those flat stones, which form so considerable a proportion of vesical calculi (see fig. 5 and 7).

The flatter a stone is, the further the extremity of the branches grasp it from its circumference, and consequently the nearer the fracture takes place to its centre, if it be very wide (fig. 7). If the stone measure an inch in its longest diameter (fig. 5), it is still more favourable, for then the branches grasp the whole width of the calculus, and in a few movements of the small lever, it is not only reduced to fragments, but the greater part of it is ground into powder. When the stone is flat, but very large, the fragments produced are generally flattened, from the calculus having itself been of that shape, and are still in perfect relation to the power of the "brise-coque," which pulverizes them the more completely in proportion to their small dimensions.

The thicker a flat calculus is, the greater is the difficulty of acting upon it at its centre, for the branches take their hold nearer the circumference (fig. 6); but this circumstance, although it may at first be considered as unfavourable, is, on

the contrary, an advantage; for the "brise-coque" acting near the edges of the calculus, does not attack it with the disadvantages which must result from its thickness, but under the most favourable circumstances. In fact, instead of crushing such a calculus, by main force, at once, which would require an enormous pressure, the "brise-coque" first destroys the smallest and weakest portion; thus in a flat calculus of two inches in diameter, and of ten or twelve in thickness, (which, however, approaches the oval shape, and ought first to be attacked by the "évideur à virgule,") the branches of the "brise-coque" would take their hold at eight or nine lines from the edge, which being the thinnest part of the stone is most easily acted upon, and is crushed on account of the layers being at this spot, in such stones, less adherent together.

A stone of ten or twelve lines in thickness, is the limited extent to the power of the "brise-coque," which, as we see, becomes more efficient in proportion as the thickness diminishes. It can, however, be employed very advantageously, when the stone is ten lines in its smallest diameter, especially if branches of two inches and a half or three inches in length, can be used; under these circumstances an oval stone of these dimensions may be attacked by the "brise-coque," without having been previously weakened by the "trois-branches à virgule," or the "perce-pierre," but its

action is still more rapid on such a calculus, when it has been previously attacked by these instruments. Our reasoning is at present relating to stones of excessive hardness, for the "brise-coque" comminutes with the greatest ease, those of an inch in thickness, which are moderately hard.

When the "brise-coque" acts upon a flat stone of considerable thickness, and seizes it at eight or ten lines from the edge, with branches (similar to those of fig. 6), the calculus is usually broken into two or three pieces approaching the cubical shape, which is desirable, inasmuch as a stone which before from its shape was with difficulty seized and acted upon by the "virgule" or "perce-pierre," becomes perfectly adapted to the action of these instruments.

If we examine what shape the fragments resulting from the action of the "brise-coque" most frequently assume, we shall find them generally cubical, and devoid of asperities, which admits of their being expelled from the bladder through the urethra with facility; this circumstance is of great importance, for it is on the manner in which the fragments are passed that depends in a very great measure the little pain patients experience, and the rapidity with which they are relieved of their detritus.

If, in the last place, we remark how the instrument is closed when its action is completed, we shall find that the two bill-shaped extremities of

the branches, are brought together by means of the alternate movements of the lever (*g*), with a degree of pressure so great, as only to allow a quantity of stone to remain in the cavity they form sufficient to fill it.*

* This is not one of the least advantages which the "brise-coque" possesses over the "perce-pierre" in the comminution of fragments. In general the "perce-pierre" is withdrawn from the bladder, bearing with it a considerable quantity of detritus, amalgamated with fibrinous matter, which renders the extremity of the instrument when it is drawn out, larger than it was when first introduced; this produces distension of the urethra, and sometimes laceration; it is very fortunate when a fragment does not project between the branches, for it is seldom a surgeon can get rid of this detritus with the drill, however careful and persevering he may be in his attempts.

I will here remark on this head, that M. Civiale, in some parts of his work, maintains having withdrawn entire fragments from the bladder with his instrument. This practice is not, in my estimation, accordant with the delicacy required in the manœuvres of lithotrity; and on this subject it is important to attend to the following train of reasoning.

The "perce-pierre" must never be drawn from the bladder with any detritus, because:

Either the fragment is of considerable size, and enlarges the extremity of the instrument by distending the branches so that it cannot pass through the urethra without causing more or less pain, under which circumstances it is far preferable to comminute it in the bladder, from which it will be voided with the urine without difficulty.

Or else the fragment is small, but projects between the branches, when the instrument ought not to be withdrawn, for the urethra would be torn; it is therefore better to pulverize the fragment in the bladder, which will expel it.

The shape of the fragments which results from the manner in which the layers of the stone are broken and separated, by the action of the "brise-coque," is worthy of observation, and I conclude what I have to say on this instrument, by calling attention to this point.

We will now proceed to examine some other instruments, which are used, more or less directly, as accessories to those we have just been studying.

Or, lastly, the fragment is too small to enlarge the end of the instrument, or to project between the branches, and in this case only it may be prudently withdrawn with the detritus; but as nothing can lead the surgeon to conclude that such is the case, he can never, without imprudence, draw out any stone in his instrument, and the more so, from the facility with which so small a fragment might be reduced into powder with the drill.

In a word, it is committing a great fault to extract a fragment from the bladder with the instrument without being quite certain that it is completely enclosed between the branches, and does not enlarge their extremity. The "brise-coque" can alone give us this certainty. We shall be more convinced of this if we bear in mind that the canal must, above all, be kept secure, for it is in the sound state of the urethra that the patient finds his anchor of safety.

ACCESSORY INSTRUMENTS.

In order to apply the instruments we have been examining, and which are destined to destroy vesical calculi, we must have recourse to other constructions, called *accessory instruments*, because they only assist in the comminution of stones, without acting directly upon them.

Among the most important of the *accessory instruments*, we find the *recto-curvilinear sound*, with which the preliminary catheterism is performed, and by means of which we inject the bladder. The *syringe*, with which we inject water into the bladder, and which we have called "seringue chirurgicale," *surgical syringe*, from its peculiar construction; the *drill-bow*, by means of which we give a rotatory movement to those instruments which act progressively upon the stone; the "repoussoir à main," the *hand-vice*, with which we push forward the perforator of the "perce-pierre," when it is placed in the "support fixe;" the *conical sound*, which is employed to dilate the orifice of the urethra, so as to prepare it for ad-

mitting the instruments with facility; "la clef," a sort of *turnscrew*, with which we tighten the little screws attached to the end of each branch of the "évideur à forceps;" and lastly, the little *syphon*, which enables us to inject water into the bladder through the instruments themselves when it is found necessary.

Although these are only secondary instruments, they are, nevertheless, of absolute necessity, and we will, therefore, consider each one in following the course we have hitherto adopted.

ON THE

RECTO-CURVILINEAR SOUND

AND

SURGICAL SYRINGE.

When patients afflicted with the stone could only be relieved by running the risks of lithotomy, they were subjected to an examination with the sound, which chiefly had for object to acquaint the surgeon whether the bladder contained a calculus or not; when the cutting operation was to be performed, this was a circumstance of the greatest importance, since it could only be the certainty of discovering a stone, and extracting it, that could induce a surgeon to expose a patient to the dangerous consequences of one of the most serious operations of surgery. Thus, the only thing required by the lithotomist is, to ascertain that a stone exists, and to have a tolerably accurate idea of its dimensions, so as to know whether it is large or small; its intermediate size and shape

are of little importance to him, and the knowledge of them would only be an indication to enlarge or diminish his incision accordingly. With respect to the form and capacity of the interior of the bladder, it is hardly a motive of consideration for a surgeon performing the operation of lithotomy, to whom it is quite immaterial to extract a calculus from a large or small bladder, regular or not, &c. These considerations, with respect to lithotomy, are quite of a secondary nature, and induce little or no changes in the manner of operating. For this reason the lithotomist only sought to give to his sound for making the exploration, a curve best adapted to insure an easy introduction through the urethra. With a large curved sound he discovers the calculus by striking it with the convexity, which portion of the instrument goes naturally to the fundus of the bladder, where the stone, from its specific gravity, is usually placed. If under certain circumstances he wishes to have a more correct idea of the calculus he has discovered, the sound, from its extensive curve, prevents him from directing its extremity to the lateral parts of the bladder, for it is in continual contact with the superior part of the organ, so that he cannot form very exact diagnostics as to the size and shape of a stone which he feels so imperfectly.

The lithotomist, moreover, only having for object to assure himself of the existence of a stone, usually explores the bladder when it con-

tains little or no liquid; he sometimes meets with a partial distension, resulting from more or less urine, and takes advantage of this circumstance for making a more careful examination; but he does not consider a distended bladder necessary for attaining the end he has in view, since he frequently empties this organ of all the urine it contains, in order to arrive at placing the calculus in contact with the convexity of the sound, with a greater degree of certainty.

If the *lithotomist* does not deem it requisite to explore the bladder carefully, in order to form correct ideas as to its state, and that of the stone contained in its cavity; the *lithotritist*, on the contrary, seeks to be intimately acquainted with the organ in the interior of which he is to manœuvre his instruments, and with the stone upon which he is to make them act.

The lithotritist, after having discovered a calculus, must be able to appreciate its size, shape, density, composition, and position; must know the form and dimensions of the urethra, those of the interior of the bladder, the more or less regularity of the parietes of this organ, its extent from the posterior to the anterior part, its depth below the neck, its width, and lastly, its degree of contractility.

These minutiæ are to him of the greatest importance, since they enable him to act with the precision his mode of operating requires, and

regulate him in choosing an instrument best adapted to accomplish the purpose he has in view with rapidity; he must therefore employ a sound so constructed, as to enable him to acquire a knowledge of these details with facility, and with as much exactness as possible, without fatiguing the patient or giving him much pain.

To this intent, the *recto-curvilinear sound* was constructed, so called, because one portion of it is completely straight, and the other curved, according to a law which we will hereafter lay down; and the *syringe with rings*, or *surgical syringe*, so called because it can be handled with greater ease and delicacy than ordinary ones, and can consequently be used with greater advantage in operations requiring the use of a syringe.

These two instruments, besides being requisite for performing a preliminary examination of the bladder, are also employed for injecting water into that organ, which must always be done before the operation is commenced, and above all, for placing the calculi in the most favourable position for the instruments to act upon them efficiently and rapidly.

Being assured of the importance of the *surgical syringe* and *recto-curvilinear sound*, we will examine them separately.

Construction and Mechanism of the Recto-Curvilinear Sound.

It is a silver sound, hollow, and from two lines to two lines and-a-half in diameter (pl. 4, fig. 1). The body of it, which extends from the "pavillon" to the commencement of the curve, is perfectly straight, and seven or eight inches in length; the curve, which commences at the extremity of the straight portion, is equivalent to the fourth part of the circumference of a circle, described with a radius of an inch and-a-half. There are at the vesical extremity of the sound, two small eyes placed laterally; at the extra-vesical extremity, a cork is fixed, in which there is a hole to receive the pipe of a syringe, so that the bladder can be injected with liquid, without fear of any being spilt; by opening or shutting a cock placed at this part of the sound, the water may be injected into the bladder, retained there, or allowed to escape.

Such is a general idea of the *recto-curvilinear sound;* when we treat on the manœuvres of the operation, we will, in a chapter entitled, "*On the Methodical Catheterism which must precede the breaking up of Calculi in the Bladder,*" become acquainted with the manner of turning to advantage the properties we have sought to develop in the *recto-curvilinear sound.* (The 2d and 3d

figures of the 4th plate, are end pieces of different lengths; but smaller than the one which generally terminates the sound; these pieces are screwed on, in the place of the large one, when it is found necessary to diminish the curve.)

On the Surgical Syringe.

It is only necessary to have used common syringes, or to have seen injections made with them, to feel fully persuaded that some addition was requisite in order that they should be handled with more ease and promptness, and without the help of both hands; when a surgeon has to inject, he is mostly obliged to maintain, with one of his hands, the pipe of the syringe, so that both hands are employed in the manœuvre, and this impedes his movements, which are rendered tedious and numerous; we must therefore seek to avoid such an inconvenience in every operation, but more particularly in lithotrity, in which a movement less may be considered as a valuable acquisition.

It was with this object in view that I constructed the surgical syringe (see pl. 4, fig. 4): it is in silver, and holds ten ounces of water; a ring is fixed to the piston, and two others are placed on the moveable top which is screwed to the cylinder of the syringe; in this top there is a hole through which the piston plays. The thumb is placed in

the ring, placed at the extremity of the piston, and the first and second fingers are introduced into the other two rings placed on each side of the top; in this manner the surgeon manœuvres the syringe with one hand, and has the other at perfect liberty.

ON THE

DRILL-BOW.

Motive for which it was constructed.—Its Construction and Mechanism.

A BOW is so well known in mechanical arts, that it may perhaps be a motive of surprise that I should give a special definition of it; but nothing, however, is more clear than the necessity of doing so.

When the power of lithotrity was limited to the employment of the "perce-pierre" only, it was not, in fact, very important to give an exact and invariable shape to the bow, as long as it brought the pulley into action, which rotated the drill, that was thought sufficient. But since the construction of the *excavating instruments*, the manner of manœuvring the bow has undergone a great change, and is no longer so simple; it is not sufficient to rotate the pulley mechanically, but we must vary the movements, which must be sometimes slow, sometimes rapid, sometimes firm, some-

times in advancing, sometimes in retreating, and lastly, sometimes in a spiral direction. It is in order to perform these manœuvres with the greatest ease possible, that the drill-bow represented (pl. 4, fig. 5) was constructed.

This bow is 18 or 19 inches in length; we did not think it advisable to make it so long as those generally used in lithotrity, for the string is then too loose, and the movements of the hand are not conveyed so easily and correctly to the pulley.

There are three things to consider in the bow; the handle, the blade, and the string.

The handle is from three inches and a half to four inches in length, it is hollow, and consists of two pieces which screw together. At that part where the blade is fixed in the handle, there is a hole from which the string proceeds; this hole communicates with the interior of the handle in which is kept an extra length of cord, in case the one attached to the bow should break.

The blade is 15 inches long, nearly straight, and of considerable strength; it is fixed in the handle, and at its extremity there is a small curve, which terminates in a hook.

The cord is retained in the handle by means of a knot, and proceeds through the hole before-mentioned, which is placed at about an inch from the part where the blade enters into the handle; so that when the bow is strung, there is room between the string and the handle to introduce

the finger and tighten the cord, which is often found useful during the excavation. Finally, the cord is at one end formed into a loop, the knot of which must correspond exactly to the height of the hook.

The manœuvres of the bow will be explained when we consider the *instruments for supporting*; for their action being so intimately connected, it would not be right to make any distinction between what we have to say of them both.

We will conclude by remarking, that to handle the bow with precision and perfection requires long study, for it is on the movements of the bow that depend, in a great measure, the more or less rapid success of the operation; to bring the excavators into action in the interior of a calculus by means of the drill-bow, is attended with its difficulties and delicacies as when, under other circumstances, a similar instrument is employed to charm and delight our ears.

ON THE

HAND-VICE.

Since we did not approve of the "chevalet" to support the instruments, it was necessary to construct a *hand-vice*, more suitably adapted than the "chevalet," to force the perforator forward as fast as it penetrated into the stone. By the means we employ, the pressure on the drill, being under the immediate influence of the hand, is more efficient, and admits of different degrees of force according to the nature of the stone, which varies considerably in its composition and density.

The *hand-vice* (pl. 4, fig. 6) is simply a metal tube containing a strong spiral spring; in the interior of this tube there is a solid steel cylinder, five or six lines in length, which is moveable, and can be made to depress the spring; the extremity of the cylinder is hollowed out so as to receive the end of the drill, and a circular rim, placed inside the tube, prevents the cylinder from coming out. At the other end of the hand-vice there is a portion forming a hexagon, which hinders the instrument from rolling, when placed down any where.

ON THE

CONICAL SOUND.

Frequently the urethra, being smaller at the orifice than at any other part, presents an obstacle to the easy introduction of the instruments. This is sometimes the case, although the opening is large, and arises from the lips of the orifice of the urethra not separating sufficiently, or from their being soft and sinking down under the extremity of the instrument; this circumstance renders the first introduction difficult and tedious, which might always be avoided by previously preparing the opening with a conical sound. It was for this purpose that the one drawn (pl. 4, fig. 7) was constructed. It is nothing more than a silver sound, five lines in diameter at the widest part, about eight inches in length, and which increases in diameter from the point, which is a line and a half in thickness, to about half the length of the sound.

ON THE

TURNSCREW

BELONGING TO THE "PINCE A FORCEPS."

When a calculus is seized by the "pince à forceps," and the four-hooked extremities of the branches have taken firm hold on its circumference, it is necessary to keep them in this position, which is effected by fastening the screws of each little case upon the bars or "conducteurs."

The little key (pl. 4, fig. 8.) is constructed for this purpose.

It is a piece of metal with a handle at one extremity, and two little points projecting from the other, which fix into the two holes made in the screws of the four cases. By means of this turnscrew the branches may be rendered immoveable at any degree of projection from the tube of the instrument.

ON THE

SYPHON.

We enforced in the fourth rule the necessity of being able to inject water into the bladder through the instruments themselves, whilst they were in the interior of the organ, and accordingly in each instrument we found an opening for that purpose; and it is by means of the *syphon* (pl. 4, fig. 9.) that we perform the injection.

It is formed of two gum-elastic tubes placed one inside the other, and terminating in a silver extremity, covered over with a cork, cut in such a manner as to enter with facility into the hole made in the instruments to receive it; the other end of the *syphon* is fixed on the pipe of the syringe in such a manner that not a drop of water can escape.

ON THE

"CHEVALET," RECTANGULAR BED,

AND

FIXED POINT.

Position of the Patient and Surgeon during the Operation of Lithotrity; Manner of fixing the Instrument, and of bringing it into Action upon the Stone by means of the Drill-bow.

As we now know the precise motive for which each of the lithotritic instruments has been constructed, and now that we completely understand their construction, mechanism, and action, let us, before we apply them to calculous patients, or rather before studying their manœuvres, consider the position in which we shall place the patient, and what means we shall employ to hold the instrument whilst it is acting upon the stone.

If we have made great alterations in the lithotritic instruments, according to the different form and size of calculi, so these varieties have induced us to make new improvements with regard to the position of the patient, and with regard

to the manner in which the instrument should be held.

We have already observed, that when the calculus is small, the action of "perce-pierre" is sufficient; but that when it is too large to be broken, after one or two perforations made by this instrument, we must then have recourse to some method of excavating it. Now, whether the simple perforation be sufficient, or whether we are obliged to have recourse to this mode of excavating, we must have means of support suitably adapted to the means employed for destroying the stone. When it is small, we may place the patient on a common bed, and use the hand only for breaking down the stone, or the bow made to act by means of a "chevalet;" but when the stone is larger, and requires the use of the excavating instruments, we then place our patient on a particular kind of bed; and we also fix the instrument in a manner better adapted for the play of the "*évideur*," which adds to the perforating action, from the fore to the back part, a lateral action, and which requires, in order that it may be performed properly, or even at all, that the instrument should be fixed with much more firmness; thus we see that the precautions necessary to be taken are in direct ratio to the difficulty of the operation.

We shall begin by describing the position in which we ought to place the patient when we are going to perform a simple operation, for which

we consider it sufficient to employ the "perce-pierre," made to act by means of the "chevalet," held by an assistant.*

On the Position in which the Patient should be placed when we operate with the "Perce-pierre" sustained by a "Chevalet" held by an Assistant.

When we find that a patient has only a small stone, which may be easily destroyed by the "perce-pierre," it may be sufficient to place him

---

* We very seldom use the "chevalet," and hardly ever place our patients on a common bed; our mode is more rational, and more secure; we give the description of the "chevalet" in this book, and explain the manner of using it, because in simple cases it may be sometimes useful, notwithstanding its defects. The object of this work is not only to shew our mode of proceeding, but to explain the art in general, and the means it requires: it is with this view we mention the "chevalet;" besides, the science can only become clear by forming comparisons, and, consequently, we must not omit describing what lithotrity was *before* the present time, with regard to the means of support, in order to compare it to what it *now* is in the same respect. If such had not been our motive, we should not have occupied ourselves with describing those means which we reject from our practice, even in those cases, the simplicity of which renders less necessary the numerous precautions required in the operation of lithotrity; for we consider ourselves obliged, in simple cases as well as in others, to use every means which can afford the patient the most favourable chances of success; we shall perceive at the end of this article how much these chances are increased by the use of the *rectangular bed*, on which we place the patient during the operation.

on a common bed; and, in order to support the instrument, to use a "chevalet," held by an assistant, and similar to that employed by some mechanics. We shall now explain this apparatus, and the manner of making use of it.

The patient should, if it can be managed, be placed on rather a hard bed, neither too high nor too low, in order that the surgeon, during the manœuvres, and whilst he uses the bow, may not be obliged to stoop, from the bed being too low, and that the movement of the bow may not be constrained and difficult from the bed being too high.

The patient ought to lie upon the bed in such a manner, that the left leg may rest upon the mattress, and the right be supported by a sufficiently high chair; by this means the pelvis will be placed upon the edge of the bed. Care should be taken to raise this part with a firm pillow; the trunk should lie nearly flat, and the head and shoulders should be a little raised. Such is the position in which we must place the patient upon a common bed. If we have a sofa without a back, it is more convenient to operate upon, for the patient may then lie down naturally; we are then to raise his pelvis, and desire him to separate his thighs, and to bend his legs slightly; being placed in this manner, with the body and thighs nearly on a level, so that there will be sufficient room for the bow to play freely, the surgeon may proceed to the operation.

If the patient is lying upon a common bed, with one foot on a chair, as we mentioned, the most favourable position in which the surgeon can place himself, in order to introduce his sound, is opposite his patient. If, on the contrary, he is upon a sofa, so that his two heels rest upon the same plane as his body, the surgeon must stand on one side to introduce the sound, which is less convenient. If the surgeon has introduced his instrument in front of the patient, he must pass to his right when he manœuvres; if, on the contrary, he has introduced it from the right side, he must remain where he is, and must make those manœuvres in order to seize and break down the stone, which we shall describe presently, when speaking of the application of the "perce-pierre."

As soon as the surgeon has grasped the stone between the three branches of the "perce-pierre," he ought to calculate by the length of the stem of the *perforator*, if the stone is small enough to be crushed by the simple pressure of the drill, or by rotating it with the hand; he ought to make the attempt, but if it does not succeed, this rotatory motion of the drill will also be of service in shewing whether it will work freely when turned with the bow. But to use the bow, he must add to his apparatus another instrument, which is called the "chevalet," and the construction of which we shall explain before proceeding to the manner of using it.

On the "Chevalet."

The "chevalet" is an instrument destined, 1st, to support the "perce-pierre," by the aid of an assistant; 2dly, that the operator may give a quick rotatory motion to the drill by means of a bow; and, 3dly, that the drill may, as it perforates, be pushed forward against the stone.

Let us now see how all these objects are accomplished by means of the "chevalet," the construction of which we shall first examine.

Construction of the "Chevalet."

The "chevalet" is represented (plate 5, figs. 1, 2, and 3.); it is composed of two pieces, which together fulfil the objects for which this instrument was invented. We call the first piece the "support" (fig. 1.), and the second the "repoussoir" (fig. 2.). They are named from the different uses to which each part is destined.

The "support" (fig. 1.) consists of a curved part (*a.*) and a straight part (*b.*); at the top of the curved portion there is a square mortise (*c*) which is to receive with ease that part of the instrument which we have named the "armure." The straight part is the same size throughout; it is polished, and from eight to ten inches in length, about two lines and-a-half thick, and about four or five wide.

Where the straight and curved parts unite, there is a kind of oval (*d.*),* which is joined to the piece, and allows the assistant to hold it firmly, whilst the surgeon is perforating the stone.

The "repoussoir" (fig. 2.) is more complicated, it consists of an upper and lower portion; at the lower there is a mortise (*a.*) which is to receive the straight part of the "support," and in which it glides with perfect ease, like a slide. A screw (*b.*) below, fixes it upon the "support" when required. The upper part has a kind of tube (*c.*), in which there is a spiral spring.† In this tube there is a small moveable steel pin (*d.*) which is so

---

* This oval is an addition which I have made to the "chevalet."

† The spiral spring appertains to M. Civiale, and is a very useful and necessary addition when the "chevalet" is employed. If, however, I made use of this means to support the instrument, I should construct the "chevalet" in such a manner that the tube (*c.* fig. 2.) which contains the spring, should be made to advance by means of a screw, independently of the "repoussoir," like the "chevalet" employed by workmen; this instrument, in its present state of perfection, is due to M. Leroy, who acknowledges having borrowed the idea from M. Ducamp; but the primitive idea belongs to Dr. Gruithuisen, who recommended to rotate the drill in the same manner as a watchmaker; and expressed himself in the following manner: "When the stone is seized by the metallic loop, and drawn towards the external tube, it is brought into contact with the drill, which is to be rotated by means of the bow in the same manner as watchmakers do to perforate metal."

(A translation of the memoir of Dr. Gruithuisen, will be found in my letter to the Academy of Sciences, page 80.)

placed, that when we press upon it, it makes the spiral spring yield, and when the pressure is removed, this spring forces the pin out; it is thus so adapted, that it pushes forwards the stem of the perforator, according as the drill head at the end of it advances in the stone. A screw (*e.*) placed above the "repoussoir," fixes the little steel pin, when required; this pin has, at its outer extremity (*f.*), a small hollow to receive the end of the stem of the *perforator*; there is a notch (*g.*) at the upper part of the little pin, in order that when unscrewed, this pin may not escape from the tube, although it is at the same time free, and plays with perfect ease, obeying the impulse of the spiral spring.

These are the two parts which compose the "chevalet;" let us now examine the manner in which it is to be used.

*On the Manœuvring of the Chevalet.**

We left the operator after he had seized the

* Although the description of the manœuvres of the "chevalet" ought to be placed in that division which treats on the operation, and which will constitute the second part of this work, I have, however, thought it preferable to give the manœuvres of the instruments which serve to support the lithotritic apparatuses, at the same time that I give the definition of their action, and mechanical construction. The details on the manœuvring of the "chevalet," the *bow*, and the "point fixe," will also enable my readers to form some idea on the course I shall follow in describing the manœuvres of the instruments in the second part.

stone, and found it necessary to use the "chevalet," in order to perforate it.

The assistant is to have the "support" and "repoussoir" separate,* he must push back the little steel pin upon the spiral spring, and then fix it there by means of the screw.

The stone being taken and fixed in the "perce-pierre," the surgeon is to hold this instrument with the left hand, whilst he takes the "support" in his right, and places the "amure" in the mortise; holding the instrument and "support" in their place with the left hand, he must then take the "repoussoir" in the right, and join it to the "support;" he is then to fit the extremity of the *perforator* into the little hollow at the end of the pin, to tighten the screw, (*h.* fig. 2.) which keeps the "repoussoir" and the "support" fixed, and to unscrew that which holds back the pin, in order that this pin, yielding to the impulse of the spiral spring, may push forwards the *perforator* as the drill acts upon the stone; all this being adjusted, the "support" and the "repoussoir" represent (fig. 3).

This done, the surgeon once more examines if

---

* He may also present them to the surgeon united together.—The "repoussoir" must then be placed on the extremity of the straight portion of the "support." In my estimation it is better to keep the two pieces separate, which plan is less likely to embarrass a young or inexperienced operator.

the *perforator* turns readily, and then giving the instrument thus placed, into the hands of an assistant, he takes the handle of the bow in his right hand, and holds it between the palm and the little and ring fingers; laying hold of the cord between the thumb and fore-finger of the same hand, he applies it upon the pulley of the instrument, and places it, with his left hand, in such a manner that the middle finger of the right hand may catch it, and carry it under the pulley so as to surround it; he then takes away from the pulley the right hand, which, however, still keeps hold of the two ends of the string to prevent it from leaving the groove of the pulley, and takes the lower one in the left hand, which, without quitting the cord, is to lay hold of the bow about three inches from the hook; holding thus with the left hand, the end of the bow and the cord, which he takes cares to keep extended, that it may not slip from the pulley, he lets go the handle held in the right hand, and with it takes the end of the bow, and bends it, whilst with the finger and thumb of the left hand, he carries the knot over the hook.

When the surgeon has thus hooked the loop, he is to hold the bow in its proper position with his left hand, whilst he takes the handle in his right; he must then, with the left, take hold of the instrument and "chevalet," where they are held

together by means of the mortise of the "support."

The assistant supports the whole apparatus, which the surgeon also holds with his left hand; whilst with his right he takes the handle of the bow, and every thing is thus arranged, for the stone to be perforated as soon as the drill is rotated.

The surgeon is to commence the perforation of the stone, by moving his bow at first slowly, in order that the drill may make an impression upon the surface of the stone; this being made, he may work it more rapidly, always taking care not to jerk it, as this would be painful to the patient; he is only to move the arm which holds the bow, all the rest of the body is to be motionless, and the whole length of the bow is to be drawn across the pulley.

As soon as the *perforator* has penetrated into the stone, as far as the construction of the instrument will allow, the surgeon is to withdraw his bow, and the different pieces of the "chevalet," in the same order as in uniting them.

To remove the bow, the assistant is still to hold the instrument, and the surgeon takes the end of the bow in his left hand, leaves the handle which he held in his right, and with this hand takes hold of the shaft of the bow and bends it, whilst he carefully unhooks the cord with the other; he then undoes the screw which fixes the "repoussoir"

on the "support," and first removes the former of the two, and afterwards the "support" itself.

During the whole time he is to take great care to keep the bow in a right angle with the axis of the pulley, for if he turns it on one or the other side before the cord is unhooked, it will slip from the groove of the pulley, and give a shock, which may prove painful to the patient. This precept must be attended to, not only when the surgeon relaxes, but also when he extends the bow.

The "chevalet" being removed, he is next to endeavour to grasp the fragments of the stone, if it has been broken by this perforation, or if it has not, he must seize the stone again. If there are only fragments, they may be crushed by the pressure of the *perforator*, but if the stone remain entire, although perforated, he must again use the "chevalet," and go through the same series of movements.

During these manœuvres, the assistant is to remain opposite the patient, which he may easily do, whether he be lying upon a common bed, or a sofa without back or sides. In this latter case, the person to be operated on should be placed sufficiently near the end of the sofa, for the assistant to hold the "chevalet" without inconvenience. He must take care to hold the forceps charged with the stone in the centre of the water contained in the bladder, and to avoid carrying the instrument towards the fundus, and more

especially towards the neck, for when the branches of the instrument are thus in contact with this part of the bladder, the patient feels a disagreeable vibration; he must also be careful to hold the "repoussoir" in readiness for the surgeon, and each time the surgeon returns this piece, he is to push back the steel pin upon the spiral spring, and to turn the screw which keeps it back, so that when the surgeon has adjusted the end of the stem of the *perforator* in the hollow of the pin, he may only have to loosen this screw which retains the pin, in order that the drill may be pushed forwards against the stone.*

This is the mode of rendering all the steps of the operation as short as possible, when we have only the "chevalet" and the "perce-pierre" to perform it with, which latter instrument, although it appears simple, is rather complicated.† Let us

---

* The details which I have given here may perhaps appear too minute; but if a surgeon, unaccustomed to use a drill-bow, wishes to place it on a pulley, he will feel convinced that it is not so easy as he might imagine, unless he proceeds by order. In lithotrity, the chief aim is to abridge, as much as possible, the movements and duration of the operation; and it is this which renders it so necessary to proceed methodically. The precepts which the manœuvring of the drill-bow required, will render still more evident how much more important and numerous will be those relating to the manœuvres of the instruments.

† Let it be understood that the simplicity of an instrument must be estimated according to its manœuvres, and not according to the

now proceed to a system of support more suitably adapted.

As we considered that the "perce-pierre" was insufficient in those cases where the diameter of the stone much exceeded the diameter of the *perforator*, so also we considered that the position of the patient on a common bed, and the instrument worked by means of a bow, and held in its place by an assistant, was equally insufficient. We decided that, with the use of these means only, the science could not attain a high degree of perfection; for we have perceived that, although in simple and easy cases the surgeon could operate successfully, notwithstanding the disadvantageous and inconvenient position of the patient—notwithstanding the necessity of he himself being obliged to stoop, which makes his manœuvres fatiguing and difficult—and notwithstanding the instrument for destroying the stone being unsteady, which may, in some cases, injure the organ; yet, in difficult cases, he must have recourse to means more certain and more satisfactory. It is this that has induced us to construct the apparatus, which we have named the *rectangular bed*, and which we will now examine.

---

instrument itself, which may be very complicated in its construction, and yet easy to manœuvre; or, as is proved by the "perce-pierre," very simple in its construction, and complicated in its manœuvres.

ON THE

RECTANGULAR BED.

I HAVE named this construction *rectangular bed*, because the principal pieces which compose it form, when the bed is viewed on one side, a right-angled triangle. In fact, this bed cannot be constructed, and exactly fulfil all the objects necessary for the perfect performance of the operation of lithotrity, if the pieces which compose it are not disposed in the form and proportion of a right-angle triangle, as represented (pl. 5, fig. 4).

The *rectangular bed* is an apparatus on which the patient is to be operated upon with all the chances of success which can be added—first, by a position comfortable to himself; secondly, by a position convenient for the surgeon; thirdly, by being able slowly and regularly to raise the pelvis when necessary; fourthly and lastly, by the instrument being firmly held during the operation, and by the rapidity with which the instrument, when

charged with the stone, may be made to act, without the aid of an assistant. Such is the object we wished to accomplish in imagining the *rectangular bed*. Let us first examine its construction with regard to the position of the patient.

The Construction of the Rectangular Bed.

Three pieces of wood joined together (A. B. C. fig. 4) form the sides of this bed, under the figure of two right-angle triangles; these two triangles are connected together in front, and at the right angle of the triangle, by a very thick transverse piece of wood (D. D.); the two middle sides (A. A.) of each of the triangles are joined together by transverse pieces, which form the bottom of the bed, and which cannot be seen in the figure. We observe in front another transverse piece of wood (E), which supports the two short sides (C. C.) of the triangle; the two sides (B. B.) are held together in a similar manner by another transverse piece (G). Towards the angle formed by the long and middle sides of the triangle, are two holes (H)—only one of which is seen in the figure; these holes receive the two extremities of a transverse piece (I), forming the upper part of a square (K. K. K.), which serves to support the bed when we wish it to rest upon the angle formed by the shortest side (C) and the longest (B) of the triangle—as in the position represented in the figure. If, on the contrary, we wish it should rest

flat upon the long side (B), or, as it is mathematically expressed, on the hypothenuse of the triangle, this square part, being moveable, and being able to be turned under the bed, allows it to be lowered. This turning up of the square part is rendered easy by unhooking the bar (M), which is also moveable, and connected, by means of a hinge, to the middle of the transverse piece (G). It is evident that, when we unhook this bar at the point (O) from the lower transverse piece of the square frame (K. K. K.), these two pieces, being both moveable, fold one upon the other, and allow the bed to rest upon the long side (B) of the triangle—as the dotted lines of the 4th figure represent. Let us not forget this arrangement; for we shall return to it when considering the manœuvres of the rectangular bed.

On the bed is a small mattress (P. Q.), the forepart of which lies flat, and the posterior part is raised by a kind of wooden desk (R), which may be brought forwards, or pushed back, as required, and thus adapts the inclination of the mattress to the height of the patient to be operated upon.—*The inclination of this desk ought to be exactly parallel to the hypothenuse of the triangle.*

At the front of the bed, and below the transverse piece (D. D.) which unites the two right angles of the triangle, we remark two moveable

pieces of wood (s. s.), which may be lengthened, or shortened, as required, and have at their ends two sandals (U. U.); each of these two pieces plays easily in a mortise at the points (V. V.), and may be fixed by means of the pressure of a screw (Y)— of which one only can be seen in the figure. At the anterior extremity of the piece which forms the middle side of the triangle, we remark a metal button (X), to which is attached, by means of a button-hole, a leathern belt with a buckle.

At the angle formed by the long and middle sides of the triangle, there are two handles (Z. Z., only one of which is seen in the figure); these are for the convenience of letting the bed down, so that it may rest upon the long side of the triangle; and for raising it up again, so that it may rest upon the angle formed by the long and short sides. Such is the arrangement and construction of our *rectangular bed.* Let us now place our patient upon it.

On the Position of the Patient on the Rectangular Bed.

After having thrown a cloth (N) over the fore part of the mattress, and placed a pillow (W) at the posterior part, we place the patient so that his buttocks may be situated at the anterior edge of the bed, the head and shoulders supported by the inclined plane formed by the kind of desk we

mentioned, and his feet resting in the sandals.*

The patient being thus placed, lies in the position most favourable for the operation to be performed with perfection, instead of being placed in a constrained and uneasy position on a common bed, supported with pillows and cushions.—Thus, as far as regards the advantages and utility which result from the position of the patient on our bed, they must, I think, be easily perceived.†

Let us now pass to the description of the piece destined to fix the instrument, and to which we have given the name of the *fixed support*, to distinguish it from the *moveable support* with which we are already acquainted, under the name of "chevalet."

---

* I intend to make an alteration in the position of the sandals, which is to raise them, so as to form an inclined plane for the feet. By so doing, the patient will find a much more comfortable and convenient support than he does when the sandals are horizontal.

† The advantages of this bed have been contested and denied by M. Civiale:—and for what reason? Probably to depreciate my labours; for no part of this bed can be denominated useless or injurious. This surgeon, when he operates, employs all the means he can devise or *happens* to meet with, in order to place his patients conveniently; and I construct the *rectangular bed* for the *sole purpose* of always placing them conveniently wherever I may operate, and so as never to want the means of doing so;—and yet what I have done is condemned!

On the "Support-fixe."

This *support* is destined, first, to maintain firmly the instrument charged with the stone, so that it may not vibrate, but necessarily remain in the centre of the fluid, which the bladder contains; secondly, that, by the instrument being thus fixed, the apparatus for excavating the stone may be used; and, thirdly, that the surgeon may not require the help of an assistant.

Construction of the "Support-fixe."

(Pl. 5, figs. 5 and 6.) Nothing is more simple than the construction of the *fixed support;* it is a long, flat piece of steel, which is curved, and allows of being moved freely in a mortise (2) situated in the cross piece of wood (D.D.)at the fore part of the bed; this flat and curved piece of steel (3 3 3, which, in the 4th figure, is placed in the mortise (2) of the *rectangular bed*) can be rendered immoveable at will, by the pressure of a screw, the handle of which (4) is placed at the right extremity of the transverse piece (D. D.). When the screw is unfastened, the *support* is free, and can play easily.

At the extremity of the *support* there is a kind of mortise (5) cut square and with acute angles, destined to receive that part of the instruments named the "armure." A strong screw placed at the right side of this mortise is adapted to

press upon the "armure" of the instrument, which can in this manner instantly be rendered fixed. (The figures 5 and 6 represent the *support* on a larger scale; figure 6 represents it without the instrument, and figure 5 represents it with the instrument fixed in the mortise, by the pressure of the screw. The relative position of the bed, the *support*, and the instrument during the operation, is marked out (fig. 4) in dotted lines.)

On the Manœuvring of the Rectangular Bed.

There is but one single manœuvre of the *rectangular bed;* it is that of changing the position of the bed in order to give the pelvis of the patient an elevation of from forty to forty-five degrees, which we are already aware is often useful, either in searching for the last fragments, or in grasping large round, or flat stones.

When we wish to elevate the pelvis in this manner, it is to be done, by making the bed rest upon the hypothenuse of the triangle, instead of upon the angle formed between the longest and the shortest sides. The bed being thus moved, the pelvis forms with the horizon the angle necessary to alter the lowest point of the bladder.

Before lowering the bed, we must take care to support the patient by means of a belt similar to that represented (fig. 7); this belt passes behind the neck of the patient, and in front of his

shoulders, and is attached to the buckles placed at each side of the bed, and one of which can be seen at the spot (x); this kind of girdle is only intended to prevent the patient from slipping back, whilst the bed is being lowered, and is not in any way meant to keep him in a fixed position during the operation, for lithotrity never requires that the patient should be bound or even held by an assistant.

In order to lower the bed, an assistant takes hold of the two handles (only one (z) is shewn in the figure), and unhooking, with his foot, the bar (M), from the lower transverse beam of the square frame (K. K. K.), he pushes this frame under the bed, and which folding by means of the mobility of its two pivots (of which one (H) is seen), to be lowered posteriorly, and to rest upon the long side of the triangle.

When we wish to replace the bed in the horizontal position, the assistant lifts it up by the two handles, and the square frame (K. K. K.) which supports it in this position, being thus raised, returns to its place, as well as the bar (M), by their own weight.

When the bed rests upon the hypothenuse of the triangle, the assistant can, by raising it some inches from the ground, and letting it fall again, give slight shocks to the bladder, which we mentioned as being extremely useful in collecting the fragments to the lowest part of the organ.

Whilst the assistant is thus lowering the bed, the surgeon must follow the movement, and support the instrument. This lowering and raising of the bed must be done very slowly, and gradually.

When the patient is thus placed on the inclined bed, he remains absolutely in the same position as when situated horizontally, only the weight of his body, instead of being entirely supported by the mattress, is partly sustained by the belt which we took care to put on to prevent his slipping backwards; although the pelvis is considerably raised, the trunk is still in a *horizontal position*, since the surface of the desk on which he rests is exactly parallel to the long side of the triangle, which is itself parallel to the horizon.

We may however increase the ease of this position for the patient, by raising his head by means of a rather firm pillow, which is to be placed only under the head and not under the shoulders.

The Manœuvres of the fixed Support.

The *support*, or *fixed point*, being destined, first, to hold in the middle of the water injected into the bladder, that part of the instrument charged with the stone, in order that it may not be in contact with the parietes of the organ; and, secondly, to hold the instrument immoveably fixed, whilst the breaking down of the stone is proceeding; its manœuvres must be such that both these objects may be obtained.

To arrive at this end with facility, care should be taken to place the patient, so that the raphe of the perineum may be in a direct line with the *support*, and that the anus may be about four inches from the front edge of the mattress.

As soon as the stone is secured in one of the instruments, either in the simple " perce-pierre," the " évideur à virgule," or the " évideur à forceps," the surgeon ought to satisfy himself that the instrument can be moved freely in the bladder: this being ascertained, he is to carry his instrument backwards and forwards from the neck to the posterior part of the organ, holding it as horizontal as possible, until he feels it stopped by one and the other of these parts; judging from the play of the instrument, what space there is between these two portions of the bladder, he is to calculate the middle of this space, and there place the part of the forceps which contains the stone, and hold it in this situation by means of the *fixed point*.

When he fits the *fixed point* to the instrument, he must hold the latter in his right hand, in nearly the same position as it would have if left to itself, and at the same time take the *support* in his left hand, and bring its mortise under the "*armure*" of the instrument; taking then the *fixed point* between the little and ring fingers of the left hand, he keeps the instrument in the mortise with the fore finger of the same hand; and whilst

he thus retains the whole in its proper position, he with the right hand lays hold of the handle of the screw, which is to fix the *support*, and fastens it by a half turn. (See figure 4, which shews, in dotted lines, the alteration in the position of the screw handle (4), when it fixes the *support*.) The *support* being held immoveable, one turn of the screw, placed at the side of the mortise, presses upon the "armure" of the instrument, and maintains it in its place.

When the instrument introduced into the bladder is held by the *fixed point*, it makes an angle of from ten to twelve degrees above the horizon; if the angle were smaller, that is to say, if the instrument were more horizontal, it would compress the urethra upon the triangular ligament, and would draw too much upon the suspensory ligament; if the angle were greater, the part of the instrument holding the stone would be too near the fundus, a circumstance particularly to be avoided.

Each patient, however, presents some peculiarities, which alter the position of the instrument as regards its direction, in the same manner as certain circumstances in the operation, as regards the play and mechanism of the instruments, may induce us to change the part of the organ, in which we are to place the forceps charged with the stone. We shall learn, when describing the manœuvres of the instruments, what are the cir-

cumstances which may make us place this part of the forceps sometimes near the neck, and at other times nearer to the fundus of the organ; it is, however, most commonly necessary to place it in the centre.

When the instrument is held according to these rules, the operation is mostly performed without the patient feeling the least pain; and the bow is employed when the "point fixe" is used, in the same manner as it is with the "chevalet." In fact, the external tube protects the canal from the parts of the instruments which move within; and that part which destroys the stone being maintained in the middle of the water injected into the bladder, the parietes of the organ cannot be touched.

The patient, more particularly during the time of the operation in which the stone is being destroyed, is so completely free from any painful sensations when lying on the *rectangular bed*, that he remains perfectly tranquil, and allows the surgeon the time necessary to act effectually upon the stone.

This is all that regards the manœuvring of the *support*: it is evident that it is rapid and simple. To raise the *support* to the height of the instrument, to turn the screw that holds it, and that which presses upon the "armure," completes all that is to be done, that the surgeon may be ready for the use of the drill-bow.

Such are the means which the science possesses

for placing the patient, and holding the instrument during the operation. We perceive that they are of two kinds: the one consisting in the use of a common bed and "chevalet:" which latter is only the application of an instrument well known in the mechanical arts; and the other consisting in the use of the *rectangular bed* and "point fixe," expressly constructed and suited for accomplishing the object now under consideration, which is one of the most important of the operation of lithotrity.

We hope to have added a great improvement to the art of lithotrity in the construction of the *rectangular bed* and *fixed support:* this will be more fully appreciated when we shall have taken a last comparative glance on the advantages of these means, and those of the moveable support or "chevalet." Instead of the unsteady and uncertain position of the patient on a common bed, when lying upon our *rectangular bed*, he is in a perfectly easy position; all his limbs are half bent; his pelvis is slightly raised; his feet, placed in the sandals, have sufficient and comfortable support; his trunk rests upon an inclined plane; the head is raised; the arms are free; the thighs are naturally bent, leaving the genital system freely exposed; and, lastly, there being nothing round the patient, the surgeon has ample space for the performance of all his manœuvres.

The operator is upright, or nearly so; not at

all constrained, and consequently not fatigued; he can perform his movements with precision and delicacy, and trusting to the safety of an apparatus securely held, he can make use of all his resources to destroy the foreign body he is attacking.

If the bed thus presents these undeniable advantages with regard to the convenience of both patient and surgeon, the "support-fixe" also gives the operator a security and a promptness of action which cannot be afforded by the "chevalet" held by an assistant.

Before the "chevalet" is taken from the hand of the assistant, which is always necessary when we use these means of support, before the instrument charged with the stone is fitted into the mortise of the "chevalet," before the portion called the "repoussoir" is adjusted with the stem of the perforator, before the screw of this piece is fixed, and that of the spring unscrewed, before the assistant is placed in his proper situation to hold the instrument, and the surgeon has passed the cord around the pulley: the surgeon using the *rectangular bed* and *support* has time enough to prepare himself five or six times, for making his bow act, and that without the help of any assistant. The manœuvres with the "chevalet" are consequently long and embarrassing, and do not lead to a very satisfactory result; those with the assistance of the bed are, on the contrary, rapid and easy, make

the patient avoid painful sensations, and shorten the action of destroying the stone, by all that time which was before lost, both from the bad position of the patient and surgeon, and from the insufficient means of support, which would not allow of the application of the important system of excavating calculi, or of destroying them by percussion.

ON

THOSE CIRCUMSTANCES

WHICH MAY CONTRIBUTE TO THE SUCCESS

OF THE

OPERATION OF LITHOTRITY,

RENDER IT DIFFICULT, OR ALTOGETHER INADMISSIBLE.

When the lithotomist has decided that a patient ought to be cut for the stone, there is nothing to impede the performance of the operation. Whether the bladder be capacious or contracted, the stone large or small, flat or round, adherent or moveable, the lithotomist, with his sharp instrument, can always penetrate into the organ in which the stone is deposited, and through the opening he has made extract it, if small, and if large, forcibly draw it out. The varieties in different bladders, the peculiarities of formation in certain subjects are of little importance to the surgeon performing lithothomy, who, with the determination of removing the stone, even though he may be compelled to employ force, will easily overcome all these diffi-

culties, for they are not of a nature to resist the great power and strength of the instrument he uses.

The lithotritist, on the contrary, whose object is to cure his patients with gentle means, and to whom all kind of force is strictly prohibited, who has to pass his instruments through a narrow canal, manœuvre them in a soft circumscribed organ removed from his sight, who is to act upon a stone, of which he has only obtained any knowledge by his touch, and who, to obtain the cure of his patient, has to reckon upon the fragments being expelled by the natural efforts of the bladder through the narrow passage nature has intended for the stream of urine, must meet with difficulties, the more numerous in proportion as the means he employs are more gentle, and allow of less violence. He is obliged to bear in mind numerous circumstances, which are of no importance to the lithotomist, but are to him of the greatest interest, for, acting by dexterity, and not by force, he is to turn aside obstacles rather than to overcome them.

We shall now endeavour to point out a few considerations to which this reflection gives rise, in order that we may determine the propriety of submitting calculous patients to the operation of lithotrity. We shall first consider the age; secondly, the constitution or general state; thirdly, the state of the urethra; fourthly, the state of the prostate;

fifthly, the state of the bladder; and lastly, the state of the stone.

The Consideration of Lithotrity, with regard to the Age of the Patient.

If lithotrity has been invented for the purpose of avoiding the dangers of lithotomy, its importance diminishes when considered with regard to children; for it is observed that the operation of lithotomy performed on children from six to seven years old, or even from seven to eight, does not so frequently prove fatal as when performed on the adult, and more especially on old persons.

This observation naturally leads us to regret less, that lithotrity is not so applicable in children as in persons more advanced in life.

If we turn back to the examination of those conditions, on which we have shewn, that lithotrity may be advantageously performed, we shall directly perceive that a child is rarely found under these favourable conditions.

We remarked that lithotrity was more frequently successful in those who came under the surgeon soon after the commencement of the disease. In this respect children are unfavourably situated, for it seldom happens that those who have the care of them, perceive the symptoms of stone at its commencement. An adult is at once aware, by the disagreeable sensation at the end of the penis, and by the occasional stoppage in the

stream of his water, that there is some derangement in his urinary system; a child, however, states nothing, perceives nothing, makes no complaints. During the first two or three years, the calculus, having fallen into the bladder without being noticed, continues to enlarge in that organ. If the child has reached the age of five or six years, he sometimes complains, but this is seldom the case; the sensation he feels he takes to be a natural one, and bears it for a long time; till at last the instinctive movements resulting from this painful feeling, increased to a considerable degree, denote a state of suffering, which no longer escapes the eye of an attentive mother. It is remarked that the child has frequently his hand at the end of his penis, drawing it out to ease the painful sensation existing at that part; this he does to such a degree as to produce hypertrophy. His urine stops suddenly while he is voiding it, he stamps, his face becomes red, he cries, screams, struggles, and convulsions very frequently supervene in very young subjects.

It is certainly impossible for all these symptoms not to excite attention, and determine some surgeon to be consulted, but this does not take place till the disease has become sufficiently serious for the symptoms to be thus strongly marked; and the symptoms do not assume this nature before the stone has attained the size of a filbert, or small walnut, and sometimes even larger; for calculi increase as rapidly in the child, as in the adult.

If we now consider, how small in young subjects is the passage through which we are to introduce instruments into the bladder, and through which also the fragments of the stone are to be expelled, if we also consider how difficult it is to keep a child sufficiently quiet and motionless during the operation, for the surgeon to employ all the delicacy of his tact, we shall readily conceive how difficult it must be to practise lithotrity in such young subjects, and how much those favourable circumstances which accompany the operation in the adult, are diminished in the child.

We must not forget that a stone which may be considered small in the adult is large in the child; for in lithotrity the stone must not be considered as to its absolute size, but relatively to the power of the instrument which is to destroy it, and to the size of the canal through which the fragments are to pass.

Now, the largest instrument we can introduce in a child under six or seven years, is from two lines, to two and-a-half; and the action of an instrument of this size is extremely slow, so slow, that in such cases it would not be advisable to attempt to reduce a stone of ten or twelve lines in diameter, for this would require a manœuvring of the instrument, and a repetition of its application, which would be attended with some danger.

Thus we are led to the conclusion, that lithotrity will never be so generally applicable in the

child as in the adult, the principal reasons of which arise from the difficulty of attacking the disease at its commencement, from the small size of the urethra, and lastly, from the impossibility of keeping young subjects sufficiently quiet.

Let not this decision, however, be taken in too absolute a sense, for we are far from proscribing the application of lithotrity in young subjects; we believe, on the contrary, that it may be advantageously employed in those cases, in which the stone, soon after its descent into the bladder, gives rise to symptoms, which are almost immediately observed; in such cases, the attempts made to destroy it will succeed, for the calculus will then be in fair proportion with the power of the instruments employed.

When the stone has, on the contrary, acquired a certain size, we must recollect that lithotomy performed on children is not so dangerous as on the adult; and that there are inconveniences and difficulties in lithotrity, arising from the organization and slight development of the parts in which we are to operate. Let us remember also, that the question is not exactly whether lithotrity is *practicable* in children, but rather whether, if performed, it offers *greater chances of success* than lithotomy. This we doubt, when the stone has acquired the size of a filbert before the age of three years, or of a small walnut at the age of five, six, or seven.

These observations are applicable to children in direct proportion to their age: consequently, as they grow older, our remarks become less applicable. Thus, when a child has reached his seventh or eighth year, the period when he begins to analyze his sensations; when he can appreciate the difference which exists in his urinary system, when he is in health, and when a stone is forming in his bladder—the importance of lithotrity increases for him; since each year which brings him nearer to manhood adds to the chances of success which this operation holds out to him. Facts bear us out in this opinion; for we possess examples of cures obtained in children of seven and eight years, and even under that age. The most favourable period of life for lithotrity is, then, the adult age, at which time all the organs are fully developed, the passages are large, the bladder capacious, and possessing a strong power of expulsion, the sensibility is sufficiently developed; added to which, there is a degree of attention which every person, at this age, pays to the proper performance of his functions. This is the reason that stones found in the adult are frequently small when compared to those found in children and old persons; for, being aware of the existence of these calculous bodies at an early period, the adult submits to the operation of lithotrity when he is still in a favourable condition.

Old people, the change apart, produced by age

in the texture of the parts, which deprives all the tissues of their firmness, present considerable facilities as regards the operation; their urethra is large, their bladder dilates easily, nothing prevents the stone being destroyed; but there is a very great inconvenience arising from their frequently not having sufficient power to expel the fragments. This want of power, in addition to the soft state of the coats of the urethra, and the varicose state of the neck of the bladder, which results from an organic change produced by age, and sometimes from the presence of calculi, renders the expulsion of the fragments tedious, difficult, and sometimes impossible. This inability co-existing with large stones, forms a direct prohibition to the operation. This want of power is sometimes shewn before the operation is commenced; that is, when the patient presents a great degree of debility throughout the whole body; when the urine flows slowly, as if falling by its own weight; and especially when a gum-elastic sound being introduced into a bladder containing urine, it is only expelled with very little power. Should this be the case, we must particularly avoid operating if the stone has acquired a large size—for example, from fourteen to eighteen lines; for the fragments will not be expelled; they will fatigue the patient considerably, and will sometimes lead to accidents which the stone, if left entire, would never have produced. If, however, the stone be

smaller, we may destroy it; for when reduced into very minute fragments—which, from its diminutive size, and the power of the instrument, can be done rapidly enough—these fragments may be got rid of by means of a large catheter* with a wide opening, and which we shall more minutely define hereafter, when we make a general examination of the circumstances attending the passage of fragments.

At other times, the impossibility of passing the fragments only comes on during the operation; after one or two "séances," the patient, who at first expelled his fragments, certainly slowly and with difficulty, can no longer pass them. Under such circumstances, we are obliged to have recourse to the *evacuating sound;* but we must always remember only to employ it when there are but few fragments to pass; for, otherwise, this means will be too fatiguing. It is better, when there is much

* We have only quite lately been in possession of an instrument adapted to bring fragments from a bladder not having sufficient power to expel them. The discovery of this instrument was attended with many difficulties; for, before we brought it to its present state of perfection, we went through a long and progressive series of constructions. It was of the greatest importance to avoid lacerating the urethra, which, with common sounds, so frequently happens. We have, however, succeeded in discovering a combination, which is, in our estimation, one of the most important we possess; since it enables us to restore to health many persons—and chiefly those advanced in years—on whom we should not otherwise perhaps venture to operate.

stone in the bladder, to relinquish the operation of lithotrity; for we cannot hope for a successful termination when obliged to use the sound very frequently.*

Thus we see that, as regards the age of the patient, several important considerations arise respecting lithotrity. We see that, although well adapted to cure the adult, it becomes more limited in its application the nearer the patient approaches to either extreme of life.

The Consideration of Lithotrity with regard to the Constitution or General State of the Patient.

A great degree of obesity, which sometimes increases the difficulties of lithotomy, has no influence on lithotrity. Among the patients upon whom I have operated, some were excessively corpulent; and I found that this, instead of increasing the difficulty of manœuvring the instruments, appeared to render the manœuvres easier than in spare subjects, who, at first sight, would have appeared more favourably disposed. In general, all other conditions being the same, these corpulent subjects have appeared easier to operate on, more especially as regards the seizure of the stone. We have also found greater facility in introducing the instruments in such patients. This advantage, in my opinion, arises from the urethra being held more

* This was written before I had invented the present *evacuating sound.*

firmly, and its sides presenting fewer cavities, on account of the support which it finds in the subjacent fat, which allows the instrument less latitude of motion. I have considered also, that the greater ease with which we can grasp the stone, and especially the fragments, in these fat subjects, was caused by the bladder, when distended, having a more regular and round form, and by the fundus being more elevated, so that the stone in these bladders is more conveniently situated between the expanded branches of the instruments; for there being less width in the bladder, it does not allow the stones or fragments to pass so readily and frequently to the sides. This is very clearly demonstrated, by examining the distended bladder of a fat subject, who has died with this organ in a healthy state.

If we recal to our recollection the description given of the bladder and of its internal form when distended, we shall understand how the irregularities of the organ are proportionate to the emaciation of the subject.

It must not be forgotten that we are now speaking of a subject in whom the urinary system is perfectly healthy; for we shall see in cases of disease, of enlargement of the prostate, as also in cases where the size of the rectum is increased by internal hemorrhoids, that the bladder of a fat man, on account of the quantity of adipose matter in the pelvis, not allowing it to be distended to a

great degree, is more disadvantageously modified than in the thin subject: for we know that the less space there is in an organ, the more prejudicial is any cause which may lessen that space. Emaciated subjects, on the other hand, when the bladder is healthy, present great facilities to lithotrity, on account of the large size of the bladder, which permits the branches of the instruments to be fully expanded, and have full play for the manœuvres. This is more especially favourable when we have to seize and destroy a large stone; but when we come to search for the last fragments, it is not so easy to obtain them as in the bladder of a moderately fat man.

In spare subjects the fragment is frequently lodged under the neck, which we know is often of considerable depth; and the bladder being very capacious, and having a large fundus, the fragments no longer fall so readily into the direction of the axis of the instrument; for being lodged to the right or to the left, or below the neck, we are obliged to search the more for them; and not being regular and round, like a small unbroken stone, they do not pass to the *rendezvous*, if I may be allowed the expression, where all small spherical calculi are found, no matter what may be the kind of bladder.

A great degree of organic disease appears to us a sufficient reason to determine the impropriety of the operation, especially if the stone be so large as to require our attacking it several times.

Lithotrity, in common cases, seldom produces fever or organic derangement; but an unhealthy subject, particularly one in whom some of the vital organs are much diseased, is more liable to some sympathetic affection, resulting from the more or less irritation caused in the urinary system by the manœuvres which lithotrity renders necessary. If, however, the stone is small, and can be broken in two or three operations, we are of opinion that the patient may be subjected to the operation with every chance of success; but we are also of opinion, that it ought not to be performed unless the stone causes great pain to the patient. It remains, however, with the surgeon to weigh well the advantages and disadvantages of lithotrity in these cases before rejecting or deciding upon its performance. But we would particularly impress this consideration, that the operation, when performed in these cases with the greatest care and precaution, may produce some sympathetic excitement, which generally settles upon the affected organ.

Whatever may be the accidents supervening to lithotrity in such cases, they are not to be compared to those following lithotomy, which operation ought never to be performed in such patients. Thus we find in lithotrity a resource attended at least with many chances of success, and therefore applicable to cases which would inevitably terminate fatally if submitted to the operation of lithotomy.

Another circumstance may also prohibit the performance of lithotrity, or at least may lead to a more particular consideration of it, this is, whether it should be performed in those who have a strong calculous diathesis, or a great disposition to form nephritic calculi, and in whose bladder there may be already a number of stones formed.

Besides the numerous cases which have come under my own eye, and which prove how easily an inflammation is communicated, sympathetically, to the kidnies, in consequence of a stimulus given to the bladder, I further think it useful to refer to the case of a man suffering from catarrh of the bladder and gravel, whom I treated by means of sounds, through which I injected water several times a-day, after having first drawn off all the urine and mucus contained in the organ. This patient habitually voided gravel, which, after being formed in the kidnies, descended through the ureters into the bladder, from which it was expelled with the urine. When I commenced the injections, I at first observed that the patient was somewhat relieved, but after a few days, I found that the pain in the loins increased, and that the gravel was voided in greater quantity; I omitted the injections and the introduction of the sound; the pain sensibly diminished, as well as the formation of the gravel; but the catarrh continuing, I again returned to the use of the

sound; the pain and gravel returned; till convinced by the repeated occurrence of the same phenomena, I perceived that there was an evident correspondence between the appearance of the pains, the formation of gravel, and the irritation caused by introducing the sound several times every day, and injecting water, which, although done with great care, still always caused a little pain.

This fact may lead us to think that the irritation excited in the bladder may, by sympathy, be communicated to the kidnies, and may cause that peculiar state in these organs which may make them form calculous concretions. This opinion is strengthened by the observations of many persons affected with acute gonorrhæa, who, whilst they had the urethra thus inflamed, voided red or white powder, which was deposited at the bottom of the vessels containing their urine. This deposit deserves our attention, for among these persons, there are some who had never observed it in their urine, and others who had remarked it, but not before contracting a gonorrhœa. It has also been observed, that after great venereal excess, the urine often becomes high coloured, and deposits a powder of uric acid, more frequently than under ordinary circumstances of life.

We conclude from this fact, that if a stimulus in the urethra and bladder can cause a more considerable formation of gravel in the kidnies, it ought to

lead us to consider, attentively, what advantages these patients may derive from lithotrity, before we subject them to it. Let it be understood, that I now speak of patients who have a great disposition to the formation of calculi, and have already several stones in the bladder, which would require for their removal many "séances;" for it is evident, that if a man have only a few small stones, those stones ought to be reduced, although the patient may be of a calculous diathesis. In such cases it is hardly necessary to add that the patient ought to be put on the regimen which is most opposed to that disposition, and particularly to the acute attacks of nephritis, to which he is subject.

The Consideration of Lithotrity, as regards the State of the Urethra.

If we refer to the observations made on the urethra when we were examining the urinary organs, and on the manner in which a healthy canal is modified by the introduction of a straight sound, we shall find that certain portions of the canal, or its adjacent parts, experience a certain degree of tension caused by their being brought into a straight line, to allow the passage of the rectilinear catheter.

Now, each of these parts thus brought into a straight line, yields with more or less difficulty to this law of rectilinear catheterism, and will, in proportion, offer more or less difficulty to the free

passage of the instruments of lithotrity; this will consequently increase the obstacles which may impede this operation, and will, in certain cases, render it inadmissible.

The urethra in its course, presents, as we already know, three principal points, which, by their anatomical disposition, are with most difficulty brought to a straight line; the first of these corresponds to the attachment of the urethra to the symphysis pubis, by means of the suspensory ligament of the penis; the second, is where it passes through the triangular ligament, and the third is at the neck of the bladder.

In some subjects the penis is attached to the anterior part of the symphysis pubis by a ligament, which, though rarely varying much in tenseness or laxity, yet unites it to a greater extent of the symphysis; as long as this attachment does not extend to the upper part of the symphysis, it is easy, whilst the extremity of the straight sound is under the pubis, to bring the anterior part of the urethra sufficiently down to allow the instrument to pass through the triangular ligament. But if, on the contrary, the penis is attached to a considerable extent of the symphysis and triangular ligament, as is sometimes the case, the straight sound then draws the canal downwards to a greater extent, in direct proportion to the height of this insertion. There are also some individuals in whom the arch of the pubis is extremely low, whether arising from a peculiar

formation of the pelvis, or because the triangular ligament is very wide, and the opening for the passage of the urethra low down in it. This disposition, which is frequently added to the one just mentioned, causes a considerable difficulty in depressing the straight sound, so as to get it under the pubis, arising from the extensive insertion of the suspensary ligament, added to the low arch of the pubis.

There are other individuals in whom the opening of the urethra into the bladder is naturally very high up, so that when we have introduced the sound under the symphysis, we must depress the handle considerably below the horizon, in order to enter the bladder. This difficulty is easily overcome, if it be the only one we meet with; but when it is unfortunately combined with those already mentioned, they together require that the straight sound should bring every part of the urethral canal, although some are in opposite directions, into a straight line, and consequently when the instrument is introduced into the bladder, it is held so firmly that the manœuvres are much impeded.

The surgeon in the habit of practising lithotrity will perceive immediately, by the position of the instrument, which of the difficulties just mentioned forms the principal obstacle to the easy introduction of the straight sound, and to its being freely moved when in the bladder.

In common cases, the instrument, when introduced, and left to itself, remains in a direction which makes an angle of from eighteen to twenty-two degrees above the horizon, and we can easily move it backwards and forwards. If there should be any difficulty, and that difficulty is caused by the suspensary ligament of the penis, the instrument will then form a wider angle above the horizontal line; if the obstacle arise from the height of the neck, the angle is diminished; if from the lowness of the pubis, the instrument, when left to itself, is sometimes above and sometimes below the horizontal line; but we observe that it is altogether lower, and carried more towards the anus. Lastly, if these three causes exist together, the handle of the forceps, according as the instrument is most influenced by the ligament or the neck, is, in common cases, carried above or below the angle which it forms with the horizontal line; but we cannot move it backwards and forwards without much difficulty; nor can we rotate it—a movement of much importance in the operation.

There are few cases in which these dispositions are so considerable as to prevent the performance of lithotrity. We must, however, feel convinced that these considerations must influence us considerably in forming our decision on the advantage or disadvantage of operating; for, in cases of large stones, we shall be compelled to attack them the more frequently in proportion as the

bladder requires that the operations be of shorter duration, and thus hinders them from being productive.

For these reasons, it is better to decide not to force the passage, unless the stone can be destroyed in a few "séances." The propriety of performing lithotrity in these cases depends, however, upon the degree of difficulty experienced; and it is impossible to lay down any general rules upon the subject. We, therefore, leave it to the surgeon to determine.

When there is this difficulty or impossibility in the introduction of the instrument, arising from these causes, the passage is often very large, and will admit a sound of much greater diameter than that of the instrument used. The difficulty does not, therefore, arise from the urethra not being sufficiently capacious; for often, when a large, straight, inflexible instrument will not pass, a much larger elastic bougie enters the bladder with perfect facility, on account of its bending and being flexible.

Another cause, unfavourable for lithotrity, may arise from the small size of the urethra. We remarked that this passage in the adult is in general from three lines and a half to four and a half in diameter at its most contracted part; but there are some subjects in whom, although the organs are well developed, the urethra is naturally very narrow; so that it will not admit instruments of more than two lines and a half or two lines and

three-quarters. In such subjects, the operation is difficult, from its being impossible to introduce instruments sufficiently large to have a rapid and powerful action on the stone. The fragments also will not pass out readily.

When considering the propriety of operating in these cases, we must take into consideration the size of the stone; for if it be very large, the operation must, for the reasons we have mentioned, be long and painful. But if the stone do not exceed ten, twelve, or fourteen lines, lithotrity may then be attempted with success. But should there be several calculi in the bladder, and all of this size, it is most probable that the patient could not bear a continuance of the operation.

In these patients we may endeavour to dilate the urethra with bougies; but I must say that those cases which I have treated in this manner have afforded me very unsatisfactory results. After a bougie of proper dimensions has been used, the membrane, frequently excited and irritated, becomes inflamed and contracted rather than dilated. We can only effect a dilatation by employing these means daily for a very long period, and by increasing the size of the bougies almost imperceptibly—a treatment which the patient will often not submit to, in his impatience to be relieved from his sufferings. We repeat, however, that, in these cases, it is the size of the stone which must decide us; they are similar to the cases in children, hav-

ing, however, one more favourable circumstance —that the patient remains quiet during the operation.

There is another condition which may be reckoned among the obstacles arising from the small calibre of the urethra; and this is a contraction of its orifice, or meatus urinarius. We alluded to this in our anatomical examination of the urethra: we shall again return to it when we describe the treatment to be pursued prior to the operation of lithotrity; for this disposition will give rise to a slight preliminary operation, for the performance of which we shall lay down some general rules, which will be better placed in another chapter.

Strictures of the urethra, whether accidental or morbid—whether arising from gonorrhœa (which is the most frequent cause), or proceeding from any other cause—render lithotrity difficult, or impossible. We came to the conclusion that the results of attempts to dilate a healthy canal, naturally contracted, were generally unfavourable; but in a case where the canal has only an accidental contraction, we ought to endeavour to obtain a passage for the instruments; for this contraction, instead of existing throughout the whole length of the urethra, which is endowed with life and contractility, is limited to a single point—or, at least, it seldom occupies a large portion of the canal; it is generally caused by super-nutrition of the membrane, which is thickened at the point, and is most

commonly devoid of much vitality and contractile power: it may be depressed by the dilating power of the bougies, or may be removed by caustic, or advantageously treated by these means combined together.

Notwithstanding, however, the possibility of dilating a contracted canal sufficiently to admit the lithotritic instruments, we cannot deny that this condition often prohibits the operation. In fact, it is seldom that we can, though we employ all our means, by caustic and by dilatation, enlarge the strictured part to the size of the remainder of the canal. This part always remains difficult to pass with the instrument, and more particularly for a fragment of any size, which is generally stopped, and produces a degree of irritation proportionate to the time it remains there. It is besides extremely difficult to extract these fragments when thus lodged; the attempts we must make are tedious, and give more pain to the patient and trouble to the surgeon, than the operation itself. We have met with many calculous patients who had strictures, which were of such a nature that we did not consider it justifiable to subject them to lithotrity, on account of these difficulties, which common sense must shew to be sometimes insurmountable.

We have treated very few calculous patients by lithotrity who had, at the same time, considerable strictures; all such as we have treated were

cases of small calculi, which could be easily destroyed; but although the canal was dilated to the extent of three lines and a quarter, the fragments were voided with considerable difficulty. They frequently lodged in the urethra, arising either from the strictured parts contracting on withdrawing the bougie, or from this part of the canal being without that kind of expulsive contractility which is observed in a healthy urethra, and which these patients possessed in a high degree. All the other patients had stones much too large, considering the state of the strictures, for lithotrity to be applicable.

It must now appear evident how difficult it is to decide upon the propriety of performing lithotrity in a patient with a stricture, before removing the stricture; since it is the calibre of the canal which influences the power of the instruments, and the facility with which the fragments will be voided. It is impossible to decide until the canal is dilated as much as it admits of. We must, therefore, in these cases of stone combined with stricture, when there is any doubt about lithotrity, first treat the stricture; and we may do this the more readily, as at any rate this treatment will be beneficial to the patient, even should we afterwards find that the operation is inadmissible. If, on the contrary, from the diseased state of the bladder, and the size of the stone, we at once decide that lithotrity ought not to be attempted, it will then be better to perform lithotomy at once, provided

the stricture be not so complete as to prevent the introduction of the staff.

A large scrotal hernia is not an insurmountable obstacle to lithotrity; but it embarrasses the manœuvres, inasmuch as it throws the canal to one side, and prevents our placing the instrument in the position we may judge necessary.

Stones lodged in the urethra give rise also to great, and sometimes even insurmountable difficulties, especially when the calculus has become imbedded in the canal, and can only be removed by an opening. We have met with a case of this kind. After the stone was removed, and the opening healed, this part of the canal was too much contracted to permit the operation of lithotrity to be performed, in order to remove the other calculi which were in the bladder. Lithotomy was resorted to in this patient. There is a very important consideration with regard to calculi thus lodged in the urethra, to which lithotomy itself gives rise. Before the art of pulverizing a stone in the bladder was introduced, the rule was, that, when a calculus became lodged in the urethra, great care was to be taken not to push it back again into the bladder, but to extract it by making an opening into the canal. This rule was given in order to avoid the operation of lithotomy, which must be performed if the stone be made to pass from the urethra into the bladder. But now that we are enabled, by more gentle means, to remove a stone, thus returned into the bladder,

without subjecting the patient to the dangers of lithotomy, the rule ought to be precisely the contrary—that is, the stone ought, if possible, to be returned into the bladder, and no opening made to remove it; for, if this operation be trivial when compared with lithotomy, it is an important one when compared with lithotrity. The advantages of lithotrity are still more important when we consider that, when a stone, thus lodged in the urethra, has been removed by an opening, it is frequently found necessary to perform lithotomy besides, to remove other small calculi remaining in the bladder, the existence of which was not suspected, since the stone lodged in the urethra obstructed the passage, and prevented those in the bladder from being ascertained.

A canal, the mucous membrane of which is soft and fungous, is disadvantageous for lithotrity. It does not, in general, prevent the introduction of the instruments, but it impedes the passage of the fragments; for, by their roughness, they adhere to the membrane, which does not offer sufficient resistance. They are, therefore, often stopped in their progress, and lodged in the canal, from whence, however, they are easily extracted. Canals with these kind of membranes are generally very large, and possess little sensibility: these cases are most frequently met with in old people. Lastly, there are some subjects, though certainly few in number, in whom the urethra is so extremely sensitive, that

the introduction of a gum-elastic sound produces insupportable pain. In some, this sensibility will continue in spite of all the means resorted to with a view of diminishing it; but, in the generality of cases, this disease diminishes, or altogether ceases, after the daily introduction of flexible bougies, to the use of which the urethra becomes accustomed. But we must avoid using bougies so large as to stretch the canal; for these sensitive subjects cannot bear too great extension, and, instead of being diminished, the sensibility would be increased. The simple application of moderate-sized bougies to the surface of the urethra, produces, in these cases, the desired effect much better than distension.

The Consideration of Lithotrity with regard to the Prostate Gland.

The state of the prostate has great influence on the degree of facility with which lithotrity may be performed: this gland is situated under the neck of the bladder, which it sometimes completely envelops, forming a kind of furrow, in which the commencement of the urethra and the neck of the bladder are lodged. It is evident that the difference in the size and form of this gland will have especial influence on the canal to which it is so closely connected. The state of this gland ought then to be particularly examined when considering the propriety of per-

forming lithotrity. The prostate is generally small, and of a regular form; its mechanical use is to support the commencement of the urethra and the neck of the bladder, and to give a degree of steadiness to both these parts; but unfortunately for the success of lithotrity, it is extremely liable to become enlarged when any irritating cause produces a determination of blood to this part.

When the prostate is thus enlarged it impedes the operation, both from its thickness and from its breadth. Its thickness often renders the introduction of the instruments difficult, and in those cases where the neck of the bladder is high up, the arch of the pubis low, the suspensary ligament of the penis inserted into a great extent of the symphysis, it sometimes renders the operation altogether impossible, or at least too painful, which amounts to the same thing. When it is only the thickness of the prostate this obstacle may be overcome by the regular introduction of sounds. We first employ gum-elastic catheters, into which stilettes, more or less curved, are introduced when in the bladder, so that by degrees we can depress the prostate, and thus facilitate the passage of the instruments. It is much better, when it can be done, to pass sounds with a small curve, which is entirely introduced into the bladder, and the prostate is consequently depressed by the straight part of the instrument.

When, however, this gland is very much enlarged, and has been so for a length of time, the instruments, although introduced, cannot be easily manœuvred, for the depression of the instrument, which is required in order to seize the stone, or more particularly any fragments in the fundus of the bladder, is, by this cause, rendered painful to the patient.

We occasionally meet with prostates, which, although small, are very much developed in their centre, so much so, that the prominence formed at this part has been called by some anatomists the middle lobe of the prostate.

We conceive that such a conformation would prevent the easy introduction of the instruments, but we can say nothing about it from experience, as we have not met with any case of difficulty depending upon this cause.

Sometimes the prostate forms a considerable *cul de sac*, in which the instrument may be engaged, and cannot be disengaged without depressing it considerably, or making it turn gently upon itself. It is still more difficult to disengage the instruments from this *cul de sac*, and proceed into the bladder, when there is also a small fold formed by the internal membrane of the organ. This fold, of which we have already spoken, is found at the lower part of the neck, it is semi-circular, and when well marked, it enlarges the cavity of the *cul de sac*, formed by the prostate.

Lastly, the prostate not only renders lithotrity difficult from the thickness it sometimes acquires, but by its breadth also, which, when considerable, impedes the operator very much, and sometimes renders it almost impossible to seize the stones or fragments when the patient is in the horizontal position. It is sometimes enlarged by the determination of blood to which it is so liable, more particularly when there is a stone in the bladder, to the diameter of from two inches to two and a half from the upper to the lower edge, and as much laterally: it raises the neck and increases the cavity, which we have named the "fosse ovalaire," the superior border of which very nearly corresponds to the lower edge of the prostate.

Sometimes when increased to this size, the gland encroaches upon the centre of this cavity, which then only exists laterally, this causes a deformity in the fundus, so that its antero-posterior diameter is diminished, and the lateral depressions or cavities are increased.

If with this enlargement of the prostate the bladder still has sufficient depth from the anterior to the posterior part, the stone, although remaining below the neck, and wedged in as it were, can still be seized. If, on the contrary, the bladder be contracted in its antero-posterior diameter, and more especially if, in spite of this, it has still sufficient space laterally, the stones will be found on either side, where there is great difficulty in

seizing them; and sometimes they are lodged in such a manner that it is utterly impossible to obtain them.

Not to be unjust, however, towards the prostate gland, I will here terminate by remarking that it is too often accused of producing difficulties which result from totally different causes.

The Consideration of Lithotrity with regard to the State of the Bladder.

When we examined the bladder in relation to the instruments of lithotrity, we considered each part in its natural state, and such as it is generally found; but there are some subjects in whom there is malformation in this organ, arising either naturally, or the consequence of disease; and this sometimes impedes the easy performance of lithotrity, and at other times may be so extensive as to preclude any attempt.

We have already described the common dimensions of the bladder, and have shewn that the most favourable for lithotrity is when the bladder measures three inches from the fore to the back part, and the same from side to side. The *recto-curvilinear sound*, when introduced, occasionally indicates much greater dimensions than these, and sometimes both the diameters of the bladder are very small. This latter condition is the more unfavourable in proportion to the large size of the stone, because a wide expanse of the forceps is then

particularly required; sometimes the antero-posterior diameter is only from an inch and a half to two inches, which condition is more unfavourable in proportion as the bladder is larger in its lateral diameter. When, therefore, the antero-posterior diameter is small, and the lateral diameter large, it is impossible to seize the stone. I met with one of these cases in a physician in Paris; although the stone was only of moderate size, neither my colleague M. Leroy (D'Etiolle), nor myself could ever succeed in seizing it, the instrument being introduced and expanded as much as the small antero-posterior diameter would allow, only produced a faint perception of the presence of a stone, which was always lodged laterally, and completely out of the reach of the instrument. This patient underwent the operation of lithotomy. I am, however, at present able to overcome with ease all difficulties arising from malformation of this nature.

The form of the fundus of the bladder is also sometimes altered by internal hemorrhoids; when there are many of these in the rectum, they increase the size of this intestine, and make it project into the bladder, which impedes the manœuvres of the instrument, and renders it more difficult to seize the fragments. An accumulation of fœcal matter in the rectum produces the same effect: but this may be readily removed by means of an enema.

In the last place, to conclude our remarks on the difficulties arising from a malformation of the bladder, we sometimes meet with a disposition, which has caused some bladders to be named *columnar bladders.* When this condition is only in a moderate degree, it is of little importance, and does not much embarrass the practised lithotritist; but when it is to such an extent that the mucous membrane forms small pouches, the more evident, in proportion to the contraction of the bladder, it becomes a serious inconvenience, and requires the greatest possible caution in manœuvring the instruments, and also in selecting instruments so constructed, that the hooked extremities of the branches should come in contact with the irregular parietes of the organ as rarely as possible. It is only by cautious and skilful manœuvres that we can avoid entangling the forceps in these kind of sinuses, especially when the stone to be destroyed is of large size. These sinuses are sometimes so extensive that they produce not only depressions, but absolute pouches, varying in size.

The pouches are not formed by the mucous membrane only dipping down between the muscular fibres, which constitute these cords, called columns, but they are organized sacs, having a layer of muscular fibre covered by the mucous membrane, so that they resemble small bladders superadded to the large one. It is evident that

when the human bladder presents these anomalies, lithotrity becomes of a very obscure and uncertain application. For if calculi are formed in such bladders, they will at one moment be found in the fundus; the next moment the instrument will not be able to detect them, on account of their getting lodged in one of these pouches, from which they will sometimes escape, if the cavity has a large opening, but if it be small they remain there, and occasionally acquire a very considerable size.

These anomalies are not so uncommon as might be imagined, for we have seen a great many specimens in various museums; those attached to the different hospitals in London in particular, contain numerous examples, which have been collected during the last few years, and which not only shew the malformation we now speak of, but afford us many examples we require, namely, that these pouches or sacs contain a number of stones more or less developed. We can readily conceive, that when this is the case, the surgeon requires all his tact and long practice to discover it; this he may accomplish by means of the *recto-curvilinear sound*, with which a most delicate and accurate examination of a bladder thus diseased can be made. Such a bladder sometimes presents difficulties quite insurmountable to the lithotomist as well as to the lithotritist.

Lastly, there are bladders which have two and even three lobes, that is to say, which are composed of two or three cavities, the principal one of which communicates with the urethra, and the others communicate with this principal one, by openings varying in size, some of which are not larger than the internal orifice of the urethra; so that each of these lobes resembles a small bladder, furnished with its separate neck. The two-lobed bladders, having a lobe in front and one behind, are the most common of these malformations; when the opening by which they communicate is very small, and not in the centre, this peculiar formation would almost certainly escape the most attentive examination, but when the communication is large, the surgeon can obtain a sufficient idea of it, to direct him in his examination and to regulate his line of conduct.

These malformations, though not near so common as the sacculated bladders, are yet frequently met with. I have seen several examples, and possess, myself, a bilobed bladder, having a lobe in front and one behind, in each of which there is a stone. It is, however, important to know, that if these bilobed bladders are uncommon, there is frequently a disposition, which may be considered as a similar developement in a slight degree. In fact, we meet, (and I have, myself, seen an example in a patient,) with bladders, which

are not absolutely bilobed, but in the centre of which there is an evident contraction, which is sometimes owing to an organic disposition that at one time gives an absolute form, and at another time a relative form to the organ; what is meant by a relative and absolute form has been already explained.

The dimensions of the bladder, considered in an absolute manner, also give the means of judging the degree of facility with which lithotrity may be performed. When the bladder is very small or very large, especially in its lateral diameter, it is a less favourable condition than when it is of a moderate size; when too small, it is difficult to grasp the stone from the want of space to expand the branches; when too large, a small stone or fragment is often sought for during a long time: for, scattered in a large fundus, they do not so readily fall between the branches of the instrument. When the bladder is of moderate size, every thing goes on easily; both small and large stones pass with greater facility into the axis of the instrument, and fall under its action more rapidly and with less trouble.

A diseased state of the bladder will also procure numerous indications of importance for the lithotritist.

A catarrh of the bladder is a very common

disease in calculous patients, and it gives rise to considerations of importance to our operation.

The first of these is, that a patient seldom has a stone and a catarrh of the bladder, without the latter being symptomatic of the former; it is only when the stone has existed for a long time, when the bladder is contracted and thickened, that the catarrh becomes idiopathic, that is to say, that it does not cease when the stone is removed. A proof of this is found in patients who have undergone the operation of lithotomy, and have been cured, but still retain a catarrh of the bladder after the wound has healed. These examples are rare, because, when the bladder is thus catarrhal, hypertrophied, and much diseased in its structure, it is seldom that patients recover after lithotomy. As long as the diseased state of the mucous membrane is not combined with a diseased state of the muscular and cellular tissues, producing the thickening of the coats of the bladder, and that rigidity which prevents its being distended, catarrh does not prohibit the operation.

We have, in fact, performed this operation on several patients who were thus affected, and who did not appear to have any increase of sensibility when the organ was touched; among these cases, two more particularly had so much catarrh of the bladder, that the mucus deposited each night at

the bottom of the vessels weighed seven or eight ounces, these patients underwent the operation of lithotrity, and were relieved both from their stone and their catarrh.

In both, we observed, that each repetition of the operation was followed by an evident diminution in the quantity of mucus, it did not, however, entirely disappear till some days after the patients recovered. In these subjects it was as easy to distend the bladder as in other cases. We do not mean, by these examples, to prove that the bladder may be thus easily distended in every case of vesical catarrh, we only wish to shew, that this affection of the mucous membrane does not prohibit the use of the lithotritic instruments, when there is facility in distending the organ, for the disease is then confined to the mucous membrane only.

If the muscular coat has been long involved, the bladder becomes small and contracted, and impedes the action of the instruments by its small diameter, and often also by the extreme sensibility it then has.

Although a simple mucous catarrh does not prohibit the operation of lithotrity, it is not the same when it is muco-purulent, especially if attended with a hemorrhagic disposition; for this catarrh is, generally, found in those who have suffered from stone for a long period, and in whom, consequently, the calculi have acquired

considerable size, which is in some cases another prohibition; it is also very frequently accompanied with great disease in the kidnies. These patients are not, therefore, fit subjects for lithotrity, but it is, perhaps, even more hazardous to perform lithotomy upon them. Let it be understood that I now speak of muco-purulent and sanguineous catarrhs, which have existed for a very long time, and always remain in the same state, and not of those which occur accidentally, and at distant intervals.

Thus, the mucus of the bladder only prohibits lithotrity, when the stone is very large, and when there is also contraction of the organ, arising from the thickening of its coats; it is quite clear, that if the stone be small, though the bladder be catarrhal and contracted, lithotrity is practicable, not only on account of the absolute smallness of the stone, but because, being small, it can only be of recent formation, and the contraction of the bladder is not caused by the thickening of its coats, but by the irritation arising from the presence of the calculus, which is then most commonly light, friable, and easily pulverized, but presents small crystals which resemble needle-points. When speaking of the different kinds of calculi, we explained the reason why stones of this sort caused so much irritation and catarrh of the bladder in so short a time.

As lithotrity can only restore calculous patients

when the fragments of the stone may be expelled by the action of the bladder, the contractile power of this organ ought to be ascertained before deciding upon the operation. Thus a complete and permanent paralysis, arising from some injury to the medulla spinalis, and accompanied with symptoms which denote that the other organs participate in this paralysis, at once decides the impropriety of lithotrity, for the fragments will not be expelled.* The evil is not, however, very great, for in these cases, the stone does not generally cause much pain, and in the state of partial insensibility in which the patients are, they care little about being relieved from an inconvenience which is diminished by the sedentary life they are obliged to lead.

Between, however, a state of perfect insensibility and complete loss of contractility, and the healthy and natural state of the bladder, there are many intermediate degrees, which may give rise to some special considerations.

If the non-contractile state of the bladder be so great as to lead us to conclude that the fragments will be passed slowly and with difficulty, we must take into consideration the size of the stone; for if it is large, it is probable that the bladder will not be completely emptied of all the fragments,

* I once more remark, that when this was written, the evacuating sound was not in my possession.

by its natural expulsive power. If, on the contrary, it is small, the fragments may more easily be extracted, if they cannot be expelled.

If the non-contractile state be moderate, and if the patient void his urine freely, though he does not completely empty the bladder, lithotrity should then be attempted, even although the stone may be large, for the operation in these cases has the salutary effect of giving energy to the bladder, and causing it to expel the fragments with sufficient power. We have successfully treated one of these cases, in which the apathy of the bladder was so great, together with the want of energy in the patient, that the urine, sometimes, came away from the actual overflowing of the bladder, so as to wet the sheets of the bed, during the night. After the two first sittings this patient did not pass any fragments, but after the third, they came away in considerable quantities for several successive days. This patient was completely cured, and with the more facility, because the bladder possessing little sensibility, and remaining distended a long time without contracting, was in a most favourable condition for the rapid destruction of the stone; the progress of the operation was therefore much expedited, from the patient affording me more time at each "séance" for the manœuvring of the instruments; this stone, although large, was destroyed in four applications. I have met with other patients, in whom there was a sort

of inertia in the bladder, which did not completely empty itself, but this state always ceased under the action of the instruments, in the same manner as it yields, when there is no stone, to the regular use of the catheter.

Vesical polypi and growths are occasionally found in this organ, and must influence the success of lithotrity.

It is evident that if a surgeon meets with one of these cases, he will acquire some idea of the state, if he is not absolutely convinced of it, from the peculiar sensations he would feel with the sound; he must then proceed with the greatest care and prudence, and entirely forbear, if he is at all doubtful. We have never met with such a case, or at least, which we have ascertained to be such; but we think that it would be easily distinguished when the growth is so large as to float in the bladder and be seized between the branches of the forceps. It might, perhaps, be desirable to remove these formations, if we possessed exact certainty as to the state of things, but as this certainty can only be obtained with great difficulty, it is, probably, the best course not to interfere with them. To decide, therefore, in a case of this description, we must first meet with one, and after a most attentive examination, after having repeatedly, by the same manœuvres, ascertained the presence of a soft and floating substance in the same situation, we may then, without

hesitation, decide to remove it, either with the lithotritic forceps, or with some instrument invented for the purpose.

Sometimes the mucous membrane of the bladder is simply soft and fungous; such a state does not absolutely prevent the operation, but it is disadvantageous to it, in as much as the fragments are not so readily felt, nor so easily seized; and, moreover, these kind of bladders bleed on the slightest touch of the instrument, which renders the operation less satisfactory to the lithotritist, who, in common cases, where the operation is well performed, ought never to cause any effusion of blood. But, however, these patients with fungoid and bleeding bladders, are generally relieved after the operation: a circumstance I have frequently observed to be in direct ratio of the blood lost; let it be understood that this hemorrhage must only be produced by the instrument simply coming in contact with the membrane, and not by any injury done to the organ by an unskilful manœuvre.

A varicose state of the veins, at the neck of the bladder, is also an unfavourable circumstance to the rapid progress of lithotrity. It does not prevent the introduction of the instrument, but it impedes the passage of the fragments.

Lastly, a great degree of organic derangement, whether in the bladder itself or in the surrounding parts, may render lithotrity difficult, or forbid it

altogether. We shall not stop to detail what all these changes may be, but we will point out the nature of some of them, in order that what we allude to may be understood. For example, a malformation of the pelvis, an exostosis from the interior of this cavity, unnatural adhesions of the bladder, hydatids, an enlarged ovary, or pregnancy, may alter the form of the bladder, and impede the operation.

Another cause which renders lithotrity difficult, is the great degree of contractility of the bladder in some subjects; whether the organ be at the same time possessed of great sensibility, or whether, on the contrary, this sensibility is only in a slight degree, although the parts are healthy, a small stone, not long formed, sometimes produces such a state of spasm and contraction, that the operation is, in most cases, rendered painful. We have seen in these patients, to what an extent the contractile force of the bladder may arrive; sometimes it allows a moderate injection of water, but when introduced, the liquid is immediately expelled with great force, although an instrument has been used, apparently of sufficient size to stop up the canal. But in other cases this contraction is so powerful, that it will scarcely allow one or two ounces to be injected. In other cases the water does not escape, but the instrument is instantaneously grasped, and can no longer be moved; this contraction presently ceases, and allows the

operation to be continued for a short time. These are some of the difficulties caused by great contractility in the bladder; we think that in a case of this kind, when the stone is very large, the operation is prohibited, provided this state of the organ cannot be remedied by any means, such as antiphlogistics or sedatives.

We have explained in our examination of the physiological functions of the bladder, the laws which regulate these contractions; these laws, if well understood, will regulate the conduct of the surgeon, when the contractions come on during the operation.

The Consideration of Lithotrity with regard to the State of the Stone.

As we have devoted a chapter to the examination of calculi, and the influence which their position, form, size, and number, may have upon the success of lithotrity, we shall now confine ourselves to some propositions, each of which will in a brief manner explain the degree of influence which the calculi, under each of these relations, may have upon the operation.

Thus we lay down as a rule, with regard to position, that the further a stone is from the axis of the instrument, the more difficult it is to seize, unless an instrument be discovered having its centre of action out of the axis of the straight tube.

That with regard to their form, the more round or flat a stone is, the easier it is to seize and to destroy; for these two forms are more particularly adapted to the power of the instruments. That as regards their size, lithotrity is easier and more rapidly performed the smaller the stone is. That as regards their number, the size being the same, it is easier to destroy one stone than a great many. That as regards the nature of their surface, the smoother a stone is, the more difficult it is to seize, especially when it is rather large.

These axioms may perhaps appear worthless and too simple to claim a place in this article; but let it be remembered, that lithotrity is not equally clear to every body, and that there are some who consider it as an operation which ought to be equally successful in every subject; that it is equally practicable when the stone is small, as when it is large; in a case where there are many calculi, as when there is a single stone; when the bladder is capacious, unirritable and healthy, as when it is small, irritable and diseased; it will no longer excite surprise that we lay down principles so easy as to be disregarded by some of our readers for their simplicity. May they cause this operation to be considered in a more philosophical point of view, and convince medical men, that if they have seen patients in a favourable condition who have had a small stone removed by a simple instrument, tedious in its action, and employed on all occasions;

there are other cases that cannot be prudently treated by the same means, and which require more prompt and efficient applications. We must not, however, omit to mention, that the most direct prohibition to the operation of lithotrity, is when the stone is so large as to fill the cavity of the bladder, so as not to allow of the introduction of an instrument capable of seizing and destroying it. It is as well to mention here, in order to solve a question frequently asked by unreflecting persons: that there must always be sufficient space in the bladder to allow the instruments to be properly manœuvred, and to contain the stone to be destroyed. With this we conclude this chapter, devoted to the consideration of those circumstances which may contribute to the success of the operation of lithotrity, which may render it difficult, or prohibit its application.

We trust, that after having thus minutely examined successively those organs, and their different parts which may, by deviating from a natural state, oppose the success of the operation; after having explained also the difficulty each may give rise to, we have, as it were, dissected our subject, and exposed each part; we have seen how necessary these considerations are to the surgeon-lithotritist, how many particular circumstances he must acquaint himself with, and how much tact and delicacy are required in order to perform this operation in a proper manner. His art exacts constant attention, continual care, great skill, and

long study, to enable him to decide upon the propriety of undertaking the operation, or upon the propriety of continuing it when once begun. As long as the patient is in a favourable condition, middle aged, with a small stone, a large urethra, a moderate-sized bladder, well formed, and not irritable, the means of obtaining a cure may be easily chosen and employed, at least as far as the action of seizing the stone with gentleness, of reducing it to fragments, of taking these fragments and again reducing them, can be easy. But when the circumstances are no longer favourable, when the stone is large, the bladder irritable and contracted, his task is no longer the same; more skill, more tact are required; the instruments must be more powerful, more expeditious in their action, and the surgeon must also have the power of deciding quickly, what ought, and what ought not to be done.

The lithotritist cannot always immediately decide upon the propriety of operating or not; he is often obliged to hesitate: on one side circumstances induce him to believe that it is right to operate; others may lead him to reject the attempt, and he remains undecided. This indecision might be painful to him, did he not know that lithotrity presents the consolation of safely allowing attempts to be made. The more perfect are his instruments, the greater is their power on the stone; and the more gently he manœuvres them in the bladder, the greater is the confidence

with which he may employ them; by being careful, and especially prudent, he may try, by applying the instrument itself, whether the operation will be advantageous to his patient.

He knows that lithotrity is not like lithotomy; if the latter is an operation which cannot be regulated in its performance, which cannot be accommodated to the susceptibility of the patient, nor be suspended at will, to be continued at some future period.—On the contrary, he knows that lithotrity is regulated by the desire and susceptibility of the patient, and by the will of the surgeon, that he can stop the attempts, can repeat them at long or short intervals of time, and, lastly, can accommodate every step of the operation to the feelings of the patient.

Fortunate are we to possess, in a doubtful case, the means by which we can in some measure regulate the intensity of an operation, and try what will be the result; stop if the symptoms are unfavourable, or continue if they answer our expectations. In this manner the surgeon may, often step by step, succeed in curing his patient; or even if his attempts are not completely successful, he generally finds in his careful and prudent endeavours the satisfaction of seeing that he has produced a degree of relief from pain, to which the patient had long been a stranger.

CONCLUDING OBSERVATIONS.

I HAVE now arrived at the point which finishes this first part of my work. In this is included all that constitutes the theoretical part of lithotrity—in my own conception, at least, and probably in the opinion of all practitioners, who will admit that the instruments which destroy calculi with the greatest rapidity, and with the fewest painful sensations in the organ, are those which ought to be considered as types expressive of the powers and capabilities of lithotrity. I think I may say that I have arrived at this favourable result, in many respects at least.

Keeping in mind the limited size and expansion which can be given to the instruments—limits which are fixed by nature, and therefore cannot be enlarged—I do not think that the action by which a spherical stone is grasped, fixed, and excavated, can be rendered more sure and extended than it now is with my "*évideur à forceps.*" Neither do I think it possible to give an easier or more powerful action than that which is displayed in my "*brise-coque,*" for the destruction of flat stones, and more especially of all kinds of fragments.

I believe these two instruments not only combine all the mechanical advantages of which they are susceptible as the destructive agents of vesical calculi; but, speaking from experience, I am of opinion that no part could be taken away, or superadded, with advantage.

My "*virgule,*" though an efficient instrument, and one which has already rendered me great service, is, I believe, susceptible of amelioration; and it at present engages my attention. It is the only combination, however, which has appeared to me hitherto capable of endowing the three-branched instruments with as energetic an action as its original construction will permit.

My *rectangular bed* has left me nothing to desire since I first commenced to operate upon it. It perfectly answers every object for which it was constructed, and equally satisfies all that the surgeon or science can exact. The "*support fixe*" is perfectly immoveable when it maintains the instrument, which it seizes with the greatest facility and rapidity. Nothing more can be said with respect to it.

The only thing which has yet left me seriously to desire, is a combination better adapted to grasp and break up thick oval stones than the three-branched instruments. These forceps do not answer well; a new construction is required, as I have already said, and I am at this moment actively engaged upon it. I venture to hope that

the route I have taken will lead to the production of a system which may act upon these stones more rapidly and effectually than the system of *gradual wearing away*, or even of *crushing*, effected by the "*brise-coque*:"—It is the *system of percussion*, established on principles hitherto unknown. As soon as I shall have the satisfaction of solving this new problem, I shall believe I have filled up, with the greatest advantage, the extensive map I marked out when I first devoted myself to the study of lithotrity.

I have, in accordance with my promise, indicated, in a clear manner, whatever regards my instruments. I have shewn every thing connected with their construction, their mechanism, and their action on the stones—one thing only is wanting to a perfect knowledge of them, and that is a description of their manœuvres in their minute details; but this is an undertaking of a different nature, which, from its importance, must form a separate study, and which ought to be the result of long experience. I have only given in this part of my work the *body* or *material* (le corps), as it were, and not the *mind* or *spirit* (l'esprit).

When they may be said thus, figuratively speaking, to be endowed with their *mind*, will be, when I shall put them in contact with the stone in the bladder, and when I describe how they ought to be manœuvred; orin other terms, it will be when I speak of and define the operation; then, by the

marks of reference,* I shall animate and give them a language; in teaching how they are to be prepared, to prevent the escape of water, I shall make them instruments available and efficient for the purposes of doing that in the bladder which they could before effect without.

I shall shew the manner of rendering catheterism or sounding *exactly indicative* of the stone to be destroyed, and teach in what manner the calculus ought to be placed in the organ, in order that the instrument may, with the greatest facility, be made to execute the double action of seizing and destroying.

I will explain and demonstrate by diagrams, which shall represent the instruments in action in the bladder, how the manœuvres ought to vary according to the accidental positions of the stones; and will also explain what must be done to expand the instruments, support the branches, attack the stone, fix it, and finally operate its pulverization, with the smallest expenditure of time, and the least complicated manœuvres. We shall find that these different periods of the operation have invariable and precise rules which are susceptible of explanation, and even of mathematical demonstration; for it will be admitted that the manual part of

* These marks are drawn on the plates; but in the second part I will explain with what intention they are thus disposed, without which they can only convey an imperfect idea.

lithotrity consists in the contact of bodies; which is an affair entirely physical, and which may consequently be subjected to methods of proceeding rigorously fixed.

It will be explained under what circumstances, and at what degree of inclination, my bed may be useful, when it is necessary, and what degree of influence this inclination ought to have on the success of the operation—whether it be in the preliminary stage of placing the stone—or when we endeavour to seize it—or, in fine, when we would moderate the contraction of the organs.

I will demonstrate the position which ought to be given to the instruments during their action in the interior of the bladder; and will shew that this position must be varied under different circumstances.

It will be explained what are the rules to be observed in order to inject the bladder conveniently; and it will be proved that there are circumstances in which an indication like this, though of quite a secondary nature, is nevertheless susceptible of considerations of no small importance.

The method of performing the *rectilinear catheterism* with ease, and the means of rendering it practicable when it is not so, will be described, whether the difficulty may arise from organic or acquired obstacles, or whether it may be caused by certain unusual contractions.

I will make known the laws which influence the

expulsion of the fragments, and will explain what indications are to be attended to in order to obtain their natural and easy evacuation. I will shew what is to be done when the fragments are retained in the passage: it will be seen that, from this circumstance, very important considerations arise. I will make known every thing respecting the instruments I employ, whether it be to push the fragments back into the bladder, to withdraw them, or finally to break them up in the urethra itself—the whole, without in the slightest way exposing the canal, which it is of the greatest importance to preserve from injury.

It will be shewn by what means the expulsion of the fragments from bladders which do not expel them, is effected. We shall see that the valuable instrument employed for this purpose, the use of which is so frequently necessary, obliges the surgeon to act according to precise rules, in order that the urethra may be shielded from all liability to injury.

The different means of ascertaining that a bladder contains no more fragments will be accurately detailed. I will prove that mere catheterism, or the search made with forceps, is often not sufficiently certain or conclusive; and that there are more simple and certain means of assuring ourselves, and conveying the conviction to our patient, that he is entirely and completely cured.

I will fully express my opinion on the prophy-

lactic means which may be employed for the stone, either before it exists in the bladder, or when it is already there, or finally, after the patient has had it removed. I will shew, by reference to facts, what these means ought to be, and when they ought to be employed.

Finally, I will describe the appropriate treatment to be adopted with the patient before, during, and after the operation. To this effect I will enter fully into details which will indicate what symptoms accompany it—what circumstances may retard or delay the successive applications of the instruments—and those which ought to oblige the surgeon to desist altogether. It will easily be conceived that the considerations arising from this subject will be of no ordinary interest; and to form a decision when we are to act or refuse, requires great judgment, and a power of weighing and appreciating the circumstances of the case.

Such will, in general, be the substance of the second part of my treatise.

CASES OF LITHOTRITY.

M. Chevalier, a farmer, at Combes-la-ville, aged 52, of a sanguine temperament, but also extremely nervous, experienced, during three years, symptoms of stone, which became every day more and more marked, and induced him to proceed to Paris, and to consult Dr. Pasquier, jun. This surgeon practised catheterism, discovered rather a large stone, and called me in to perform lithotrity on the patient.

I sounded M. Chevalier, and discovered in his bladder, which was rather large, but contractile and irregular in its parietes, a large stone of between sixteen and eighteen lines in diameter; scarcely moveable, and placed nearly behind the cervix of the organ, whence it could with difficulty be dislodged. The canal was large, and the urine deposited a considerable quantity of glairy sediment.

Although I was not fully convinced of the spherical shape of the calculus, on account of its being nearly immoveable, I employed the "évideur à forceps," with which I readily seized the stone, but when I attempted to lower upon it the four claws of the forceps, it escaped from their grasp, which induced me to postpone the operation for two or three days. In a second attempt I easily succeeded in capturing the stone, and the branches being depressed, each of them rested firmly upon its surface. I then practised the excavation, which lasted about ten minutes, and hollowed out the stone to an extent of twelve or fourteen lines, as was perceived by the marks on the instrument. I concluded the stone was completely excavated, and withdrew the instrument. A great quantity of powder and fragments were immediately voided, but the catheterism which I practised three days afterwards, acquainted me that the stone was not broken, but that it presented great irregularity in its form, a fact which gave me to understand that it had been extensively and deeply attacked.

Excavation being no longer possible in the fracture of this calculus, since it did not present a compact centre, I employed the "perce-pierre," with which I occupied two operations in breaking the stone, and in the subsequent comminution of the fragments.

After the last introduction of the instruments, M. Chevalier was affected, without any appreci-

able cause, with vomiting, pain in the abdomen, and fever; all these symptoms, except the vomiting of a greenish black substance, were removed, and M. Chevalier suffered, during a month or more, from an actual melæna.

Notwithstanding there remained some fragments in the bladder, I thought it prudent to postpone operating for some time, and sent M. Chevalier to Combes-la-ville, where I treated him, conjointly with M. Bancel, a physician of merit. After some trials, and with the aid of a blister to the epigastrium, we obtained the suppression of the vomiting, and I continued the operation.

In three applications of the "perce-pierre," M. Chevalier was entirely freed from his calculus.

Reflections.

The stone of M. Chevalier was not spherical; which is proved by the difficulty experienced in fixing it in the "pince à forceps," in the first attempt; for these pincers are so constructed, that it is impossible a spherical stone should be placed between the branches, and not be firmly retained. One application of this instrument is sufficient to impart an exact notion of the sphericity of the stone. The calculus of M. Chevalier was oval, and but little flattened, which enabled me, in the second application, to render myself master of it.

In consequence of this form, the excavation

could not be considerable, because the "évideur" was necessarily stopped, when it had attained that point of the exterior of the calculus nearest to the centre; and the stone being only from twelve to fourteen lines in its small diameter, I could consequently only excavate it to that extent, which clearly explains why it was not at once broken.

The excavated calculus remaining still entire after the action of the "évideur à forceps," it became necessary to have recourse to the "perce-pierre," with which I succeeded in comminuting it, after four or five applications. The application of the "perce-pierre" evidently increased the number of "séances," and yet on account of the large size of the canal, the action of this instrument was as powerful as it well could be; for I introduced, with facility, tubes of large diameters.

M. Chevalier was ill during the course of his treatment, but I doubt whether the action of the instruments could have been the immediate cause; the character of the malady, accidental as it proved to be, prevents us from forming such a supposition. A patient operated upon according to the lithotritic process, is often subject to accidents which result from the sympathy existing between the bladder and the other organs, but these affections are generally simply inflammatory. A melæna depends upon a particular morbid disposition in the patient; it is almost a specific malady, and consequently cannot easily be attributed to the applica-

tion of the instruments of lithotrity. If irritating substances be applied, the intestines will doubtless be inflamed, but melæna will not be produced.

M. Chevalier passed the detritus easily when he made water, for his canal was large, but he presented in this respect a remarkable peculiarity, namely, that when a fragment accidentally irritated the urethra, the patient fell into a state of catalepsy. All the organs remained in a state of fixedness, similar to those affected with this disease. The first time I saw M. Chevalier in this condition I was uneasy, but seeing that it was not followed by any unpleasant effect, and that it ceased altogether when the fragment was expelled by the contractile force of the urethra, all my anxiety ceased entirely. I have never seen any thing analogous in other patients.

I operated on M. Chevalier, in the presence of Dr. Pasquier, jun., the physician to whom he first applied.

M. F * * *, a student at law, 22 years of age, of an arid constitution, having a large and sound bladder, a rather narrow canal, and moderately sensitive, presented himself to me in the month of July, 1826, after having been sounded by Professor Dubois, who recognized the presence of a stone in the bladder.

The *methodical catheterism* enabled me to dis-

cover several calculi, which appeared smooth, very moveable, and consequently rounded. This determined me to the choice of the "évideur à forceps." I practised the operation at three different times with this instrument, which each time seized a stone of about twelve lines in diameter. The breaking of each stone only required an excavation of five or six minutes.

In ten applications of the "perce-pierre" I succeeded in breaking down the fragments, resulting from the excavation, into morsels sufficiently minute to be easily ejaculated. These pieces, notwithstanding the narrowness of the canal, came out with ease, for a peculiar circumstance afforded material assistance :—The patient secreted a large quantity of urine, which he retained a long time, and threw out with considerable force.

Reflections.

It may be a matter of astonishment that the "pince à forceps" should have seized entire stones with ease, whilst there were in the bladder fragments, which might have been as well seized as the entire stones themselves. But this power of *election* in the instrument is due to a very simple circumstance, and which may be easily conceived. As soon as a stone is broken, the fragments roll no longer, for they are irregular in form. The entire calculus, on the contrary, obeys every impulse which is given to it, and finds itself, in consequence,

in the lowest part of the organ. It is there the "pince servante" meets it, distinguishes it from the fragments, and without difficulty apprehends it; for the surgeon discovers the mobility of the stone by touching it with the "pince servante," and this mobility is a distinctive character of the spherical shape.

The "servante" is, however, sometimes deceived and seizes a fragment; but then its irregularity is ordinarily detected, if not, the "pince maîtresse" never fails to indicate its shape as soon as the branches are drawn down upon it.

M. F * * * had a great deal of detritus, and a narrow urethra, which renders the case interesting, and more satisfactory, for these are two circumstances which concur to make the operation difficult. The treatment was, however, sufficiently long, for it required thirteen applications of the instruments; and had it not been for the "évideur à forceps," between twenty and thirty would have been found necessary.

This patient presented a very remarkable circumstance. His bladder was endowed with an extraordinary sense of touch. M. F * * * perceived the position of the fragments in the organ, and told me in what direction to guide the instrument for the purpose of their seizure. He was well aware when the forceps was any where near them, and knew exactly when I seized them. Every time M. F * * * gave me such extraordi-

nary proofs of tact, his pelvis was elevated by means of the *rectangular bed,* in such a manner that it was never necessary to depress the instrument with force upon the neck of the organ, in order to seize the stone or the fragments; so that by not producing any painful sensations, the patient was perfectly able to appreciate and distinguish whatever took place in his bladder.

I operated upon this patient in the presence of Messrs. Pasquier, jun., and Jouanneau. M. Leroy (D'Etiolle) was present at the last "séance." During the whole period of his treatment, M. F*** experienced no febrile symptoms, nor any other derangement of health.

Jean Jouveaux, of Villebout, in the department of the Loire and Cher, 30 years of age, of a sanguine temperament, a woodcutter or reaper, according to circumstances, experienced, in the year 1821, all the symptoms which denote nephritis and the descent of gravel by the ureters. About a year afterwards the symptoms of stone appeared; and after suffering five years, he resolved to enter into the "Hôtel Dieu," in the month of August, 1826.

The Baron Dupuytren, surgeon in chief of that hospital, honoured me by confiding the patient to my care, in order that I should operate upon him publicly with the lithotritic instruments.

A careful exploration with the *recto-curvilinear sound* enabled me to discover in the bladder, which was about three inches in width, two and-a-quarter from the anterior to the posterior part, and of considerable depth below the neck, a calculus which could be easily moved. The organ was but moderately sensitive, although the urine deposited a considerable quantity of mucus, which was slimy, glutinous, and of a yellow colour; it was also adherent, and so abundant, that it covered the bottom of a vessel of ten inches in diameter, with a glairy mass of the thickness of a finger.

Notwithstanding this unfavourable condition, I thought that the operation of lithotrity might be performed with advantage, and I resolved to employ the apparatus "évideur à forceps," as the stone was voluminous, and appeared spherical from its being so moveable in the bladder.

The patient was placed on the *rectangular bed*, with his pelvis elevated to an angle of 45°; I then introduced the instrument, after having previously injected warm water into the bladder. When the forceps was expanded and drawn towards the neck, having allowed some of the water to flow out, I perceived that the stone was placed directly before the expanded branches, and instantly introduced the "pince servante" through the canal of the "pince maîtresse;" the stone was seized, and placed centrally between the branches of the instrument by which it was firmly secured.

Having raised the bed to the horizontal position, and placed the instrument in the mortise of the "point fixe," I proceeded to the destruction of the stone.

I first introduced the *perforator,* and drilled a hole of seven lines in depth; this instrument was then replaced by the *excavator,* with which I produced an excavation in the stone of about twelve or fourteen lines, when a sudden stoppage in the rotatory movement indicated that the *calculus* was broken.

This first application of the instrument lasted from ten to twelve minutes.

On injecting tepid water into the bladder through the instrument, this fluid, in which thin flakes of stone could be distinguished, was expelled white and muddy; this clearly evinced that the action of the instrument had been effectual; for in one single "séance" in which the calculus had only once been seized, and once acted upon by the "évideur à forceps," an effect was produced six or eight times greater than would have been obtained by the "perce-pierre," in several "séances," in each of which the stone would have been several times taken, and as often acted upon.

The patient found relief as soon as the stone was broken; he no longer experienced that pain and uneasiness produced by the calculus when entire; its centre being excavated, and its exterior disunited, it no longer constituted one entire mass, which so frequently struck against the

neck of the bladder during the movements of the body. In a word, Jean Jouveaux, after this application, felt a relief from pain, which he had not experienced for many years, and had not the slightest attack of fever or rigors. During several days he continued to pass fragments and powder mixed with the mucus, which was, for the first day or two, as abundant as ever, but diminished evidently after this time, until about the sixth day, when I resolved to bring away the stone that remained in the patient's bladder.

The second operation was performed with a "perce-pierre," and several fragments were comminuted, either by means of the bow, or else by crushing them against the hooks of the branches with the drill.

In seven applications of the "perce-pierre" the patient voided the stone in powder and fragments, and after each "séance" there was a decrease in the quantity of mucus, which first changed from muco-purulent, to simply mucous, and then ceased entirely.

After the eighth "séance," Jean Jouveaux was sounded by the Baron Dupuytren, and Messrs. Breschet and Sanson, surgeons to the "Hôtel Dieu," who did not discover the smallest remnant of stone, and the patient quitted the hospital without allowing me to introduce the instrument a last time, in order to assure him that his bladder was entirely relieved.

Some time after, he came to see me; I inquired as to the state of his health, and was informed that the stream of urine was not quite regular, but that its expulsion was not attended with any pain; I, however, thought it right to introduce an instrument into the bladder. After searching for some time, I felt a small fragment of a few lines in diameter, which was instantly seized and comminuted, and the smaller pieces and powder were immediately voided. A second examination with the instrument assured me of the patient's complete recovery.

Reflections.

A bad catarrh of the bladder existing at the same time as the stone, renders this case worthy of remark. It proves that when the deposition of mucus is symptomatic of the stone, it ought not to prevent the surgeon from proceeding in the operation of lithotrity; that is to say, when, as in the case before us, the bladder admits of being easily distended, and is not very sensitive.

In this case also, the excavation of the stone was as complete as possible, and took place to a considerable extent; the result of this was the production of a large quantity of powder, which was expelled without the least difficulty. This part of the operation was also completely inoffensive, as regards the organs, and free from pain; for, during its performance, I had the satisfaction to hear the patient say, "he felt himself so well, that he could wil-

lingly go to sleep." This is a proof that lithotrity, in some cases, is exempt from painful sensations.

This is the first operation of lithotrity performed publicly in France; it took place in the presence of the Baron Dupuytren, Messrs. Breschet, Sanson, a great number of medical gentlemen, and the numerous pupils of the hospital.

Dr. Neurohr, a physician of Landau, fifty-six years of age, but of a robust constitution, was attacked, on the 4th July, 1828, after riding on horseback, with hematuria to a considerable extent; and, a little while after, all the symptoms of stone appeared. Two years before this, the patient passed five or six calculi about as large as peas, and had recourse to lithontriptic drinks, but without success. In 1820, he consulted two German surgeons of eminence, who sounded him, and discovered no stones in the bladder. Nevertheless, in July, 1825, these foreign bodies became entangled in the urethra, and were extracted by means of oily injections, careful manipulations, and, lastly, by an incision, which it was necessary to practise at the meatus urinarius for the liberation of calculus of about seven lines in length. When examined, these foreign bodies, to the number of six, were recognized by Dr. Neurohr to be fragments of a calculus of which the nucleus necessarily remained in the bladder.

The hypothesis put forth by this physician was, that a fermentable nucleus, existing in the centre of the calculus, had occasioned it to burst, and had produced the separation of the fragments observed.

Concluding according to this hypothesis, Dr. Neurohr came to Paris, fully persuaded that there only existed in his bladder the remainder of a stone, of which the extraction would be easy by means of the lithotritic process; and, above all, that this would be effected in a very short time.

I was consulted, and whilst admitting the possibility of a spontaneous rupture of a single calculus, I thought it nevertheless more rational to suppose that several calculi existed in the bladder, and that their collision had occasioned the fracture of one of them, and the consequent escape of the fragments. I sounded the patient, and accordingly found several calculi which appeared to be of considerable size. I apprized Dr. Neurohr that a long time would be necessary to relieve the bladder entirely; and I found in this gentleman all the incredulity natural to a man who receives tidings calculated to afflict him.

Dr. Neurohr, who was a medical jurisconsult in his province, had obtained leave of absence for a certain time, with a view to be treated in Paris for his disease; but he could not trespass on the bounds of leave, without risking the loss of his office.

He persisted in the opinion that there only

remained some fragments of calculus in his bladder; and, thinking that my instruments would convey more exact information than a simple sound, he desired me to subject him at once to the operation, determining to have recourse to lithotomy, if the correctness of my anticipations were verified.

Under the present circumstances, I did not deem it my duty to refuse the request of Dr. Neurohr; and twice I subjected the stones which his bladder contained to the action of my "évideur à forceps."

During the time of these two applications, I seized, one after another, several of these foreign bodies, and excavated them: they all appeared to be about an inch in diameter.

Dr. Neurohr incurred no fever or even inconvenience from these applications of the "évideur à forceps," and passed after each of them a considerable quantity of powder and fragments. But seeing that his family interests demanded that he should be promptly relieved, he informed me that he had decided to submit to lithotomy, and desired it might be performed by the surgeon in chief of the Hôtel Dieu.

Four days afterwards, M. Dupuytren operated with his bilateral bistouri, and extracted from his patient's bladder *eight* calculi, of the size of walnuts, and of a rounded form, corresponding to the description I had given of them.

Of these eight stones, two were broken, a third was perforated, and a fourth excavated like an egg-shell.

Reflections.

Although Dr. Neurohr was not completely cured by lithotrity, I regard his case as much more valuable to the science than a complete cure. In fact, this case ought to attract particular attention, inasmuch as it permits us, as it were, to surprise and examine the instrument in its action. For this reason, I prefer giving it a place in this book to the insertion of an easy case of success, which teaches nothing.

Dr. Neurohr's treatment affords a proof that the action of the " évideur à forceps" on calculi is rapid and powerful, and, at the same time, that its manœuvres are but slightly painful to the organ. The first is shewn by the inroad effected in the substance of the stones; and the second point is demonstrated by the short interval which elapsed between the last application of the lithotritic instruments and the performance of the lateral operation. The Baron Dupuytren was anxious to wait until the tranquillity of the organ should have been restored; but the patient, finding himself sufficiently well, would not consent; and lithotomy was, consequently, performed almost immediately.

I operated upon Dr. Neurohr in the presence of

Baron Boyer, Dr. Boyer, jun., Drs. Pasquier, father and son, Dr. Jouanneau, and several German physicians.

M. Robillard, of Paris, a baker, fifty-six years of age, rather corpulent, of a sanguine temperament, had been troubled for two years with symptoms of stone. During the first eighteen months, these symptoms were not extremely severe; but their severity increased so much in the course of the last six months, that he was induced to consult Dr. Pasquier, jun., who sounded him, and discovered a foreign body in the bladder. He then referred the patient to me.

By my system of catheterism, I discovered a stone, of from twelve to fourteen lines in diameter, contained in a bladder sufficiently capacious, from before backwards, rather small laterally; and the base was so much raised as to be on a level with the cervix when the patient was in the horizontal posture.

Although the stone did not appear to be entirely spherical, I employed the apparatus "évideur à forceps," with which I easily made myself master of the calculus, and broke it in a few minutes, by excavating to an extent of about ten lines. A great quantity of powder and fragments were immediately ejected; and, in three applications of the "perce-pierre," which I made at intervals of

a few days, the patient was relieved from every vestige of stone.

Reflections.

This case was remarkable for the corpulency of the patient. I do not consider this state of obesity to have proved detrimental to the operation. I even observed that the fragments were seized with more facility. This arises from their not having been widely scattered in the organ, which was of moderate capacity and regular in its fundus, and thus allowed free play to the instrument. Sometimes I had even less trouble in taking the fragments than in surrendering them—a circumstance owing to the considerable elevation of the "bas-fond," which facilitated the apprehension of the fragments, but not so much the letting them loose.

I ought not to omit noticing a very singular circumstance, which I have also observed in another patient. A few days after the fourth and last application of the instruments, I sounded this patient, and clearly recognized the presence of a fragment. Two or three days afterwards, I resolved to introduce the instrument, in order to comminute the fragment which I had felt; when Dr. Pasquier, whom I had requested to introduce the sound, in order to inject the bladder, begged to know "why I was going to operate upon a man who had no vestige of stone in his bladder."

Very much surprised, I took the sound, made many careful researches, and assured myself, to my great astonishment, that there really was no sensation indicative of the presence of a fragment. I did not, consequently, introduce the lithotritic forceps; and from that time the patient has enjoyed the best health, and has never complained of the slightest derangement of his urinary organs.

This circumstance is very curious; for the patient assured me that he had scrupulously examined his urine at each period of its ejection; and it has led me to make the following reflection, which I express with diffidence, notwithstanding other facts which I have observed might give me some right to consider it as correct:—*I believe that, in some cases, it occurs that a fragment remaining in the bladder after the operation of lithotrity, is dissolved, and thus passed out of the organ.*

This reflection may also serve as an additional answer to those who see, in the possibility of leaving a fragment in the bladder, an objection to lithotrity. My conviction on this subject goes to some length towards resolving the question—" whether a fragment left in the bladder does not give rise to a new calculus?"—by the reply: *A fragment left in the bladder is dissolved nearly as often as it is left.*

From the foregoing reflections I am led to believe, that, in certain individuals, it happens that the nature of the urinary secretion changes to such a degree that it is sometimes in the condition to

dissolve a stone, which, some time before, it had evidently a disposition to form; and that there exists amongst these individuals similar alternatives of condition, which cause certain stones to enlarge and diminish alternately. This consideration tends to elucidate certain spontaneous cures of the stone, which could not have taken place but by these means—that is, if the facts collected be correct.

These reflections, however, as far as they relate to *entire calculi,* do not rest upon any facts sufficiently positive to be considered otherwise than as simple speculations.

I operated upon M. Robillard, in the presence of Drs. Pasquier, senior and junior, Dr. Marc, and Dr. Mérat, ordinary attendant on the patient.

Pierre Hunaut.—In 1824, on the 1st of September, after having committed an excess in wine-drinking, Pierre Hunaut was affected with a nephritic colic, which frequently recurred, and sometimes with great intensity, until the 23d of March, 1825, when he was induced to consult one of a class of empirics called "water-doctors," who subjected the patient to various applications of unknown remedies, from which, however, no relief was procured.

On the 5th of January, 1826, the patient experienced another attack of nephritic colic, which

was even more violent than the prior ones, and he passed spontaneously, *per urethram*, a quantity of white and coarse gravel.

On the 30th of March he was conscious, for the first time, of certain sensations indicative of a body moving in the bladder. From that moment he suspected he was affected with stone, and proceeded to consult M. Petit, a surgeon residing in Paris, who referred him to M. Leroy (D'Etiolle).

M. Leroy sounded the patient, and discovered a stone which he calculated to be about fifteen lines in diameter. He then obtained his admission into the Hôtel Dieu, under the care of Baron Dupuytren, on the 18th of November, 1826.

After a preparatory treatment, this patient was submitted, by M. Leroy, to two attempts with the "perce-pierre," but these were unsuccessful, and the stone was not laid hold of or attacked with the drill.

After these two "séances" the patient became affected with a pleuritic attack, which was removed by pursuing a suitable treatment.

On the 23d of December, Pierre Hunaut left the Hospital, with the permission of the Baron Dupuytren; when M. Leroy besought me to try to seize and destroy the calculus with my instruments.

I examined the patient with the *recto-curvilinear sound*, and found in a bladder of considerable

size, dilatable, and moderately contractile, a stone which appeared of about from fifteen to eighteen lines in diameter; smooth, moveable, but having a strong tendency to place itself under the cervix, when the patient assumed the horizontal posture.

On the 12th of January I operated before Messrs. Leroy (D'Etiolle), Jouanneau, and Pasquier, junior, with my "évideur à forceps." The stone was immediately apprehended, submitted to the action of the instrument, and broken; a great quantity of detritus was immediately ejected through the central canal of the forceps, through which, without removing the instrument from the "point fixe," tepid water was injected.

Immediately after the rupture of the stone, the patient experienced relief, and in *seven* applications of the "perce-pierre" which I made, in conjunction with my friend M. Leroy, the concave fragments or shells were sufficiently comminuted to be completely evacuated.

Reflections.

This case presents nothing remarkable with respect to the treatment. I have related it with a view of shewing the successful application of the "évideur à forceps."

The stone was voluminous, spherical, and consequently within the scope and compass of this instrument. I might affirm that the reason for which M.

Leroy did not succeed in taking the stone when it was entire, may be ascribed to the superiority of the "évideur" over the "perce-pierre," but I do not think this conclusion would be just. I am of opinion that the stone of M. Hunaut might have been taken by the "perce-pierre," and that the failure is due to the inexperience of my colleague, M. Leroy, who was then a novice in the operative part of lithotrity;* for this stone, although large, was spherical, placed in a capacious bladder, and easily seizable by the "pince à trois branches;" but if it had been taken, the result would only have been a perforation of three-and-a-half lines in

* M. Leroy had till then devoted himself exclusively to his ingenious speculations, and, although he had invented the lithotritic instruments employed by M. Civiale, he did not seek occasions of performing operations, which is only done with success by those who have a peculiar bent or inclination for it. This may explain why M. Leroy *invented* the first instruments of lithotrity, and why M. Civiale was the first to *operate*—the first was ingenious, the other was bold.

Before attempting the operation on this patient, M. Leroy had practised lithotrity but once, and that was upon an old woman, whose bladder was contracted upon a large and rough stone, and did not permit him even to open his instrument. He could not, therefore, be expected to have sufficient experience to succeed in the present case.

Whatever may be the reason of this failure, I am happy in having had this opportunity of inducing M. Leroy to persist in applying himself to the operation of lithotrity, by shewing him what I then knew; I have, by that means, enlisted in the service of science and humanity, a most dexterous and prudent operator.

diameter. It appears, therefore, fortunate for the patient, that the application of the "perce-pierre" did not succeed; for instead of being cured by seven or eight applications of the instrument, it would have been requisite to subject him to many more, and that his constitution might not have withstood. M. Hunaut, during his treatment, not only escaped every febrile symptom, but actually increased considerably in *embonpoint*, and got entirely rid of the pleuritic pain in the right side, which had continued after his discharge from the hospital.

M. Delau, of Paris, sixty-five years old, was attacked about five years ago, with pain in the kidnies, fever, and sensations of burning lines in the groins. This train of symptoms was renewed five or six times during the three succeeding years, at the end of which, after a long walk, the patient felt (according to his own expressions) something detach itself into his bladder, which immediately after became the seat of vivid and burning pain, and produced a strong desire to pass his urine. At first he found it impossible to do this, but a short time after, he ejected a quantity of pure blood. From this time all the symptoms of stone developed themselves.

After suffering two years, this patient applied to me. I introduced the catheter, and found the

bladder irritable, and presenting prominent columns, upon which the sound infringed; it was about two and-a-half inches in diameter, in all directions, and the "bas fond" was elevated. I discovered a stone nearly round, smooth, extremely moveable, very central, remaining near the cervix in the horizontal position of the patient, but easily quitting its situation when touched by the sound, or when the pelvis was suddenly raised. This stone was of about twelve or fourteen lines in diameter.

In one application of the "évideur à forceps," and in three of the "perce-pierre," the patient was totally relieved from his stone. I operated in the presence of Dr. Pasquier, jun., Dr. Deguise, and Dr. Legallais.

Reflections.

The only difficulty which this patient presented, was the existence of the fleshy columns, which were perceived in all the superior surface of the bladder, and it was important to avoid entangling the claws in any of the intermediate grooves. There is no danger of this taking place with the four-branched instruments, but with the three-branched forceps, it may, and does sometimes happen, notwithstanding the care taken to avoid it; for when a stone or fragment is being seized, one of the branches always projects above, and might pinch the bladder, especially during the

simultaneous contraction of the abdominal muscles and diaphragm. Whenever I use this instrument, I take particular care to hold the branches very short;* by this precaution the operation has been always rendered favourable. The stone was of small dimensions, and nearly spherical, the excavation, also, was so complete, as to leave little to be done by the "perce-pierre." In consequence of its roundness and small bulk, it was seized with the greatest facility.

I ought not to pass over in silence a particular circumstance which presented itself in the case of this patient, for it gives rise to a very important practical indication.

I once paid M. Delau a visit whilst he was passing his fragments, and as he had voided a large quantity in the night, he said he felt a smarting pain in the urethra, which annoyed him very much. Having observed that introducing a wax bougie, and leaving it in the urethra for a few minutes, ordinarily calmed the irritation of which M. Delau complained, I passed one of about three lines in diameter, which I desired him to draw out after ten minutes, and then left him. This he agreed to do, but after having withdrawn the bougie a little way, he perceived that it was arrested, and a moderate traction could not extricate it. He sent for me, but

* At present, in most cases, I use the "brise-coque," which has no superior branch.

not being at home, and living at some distance from my patient, I could not be with him for a considerable length of time. On my arrival, I saw M. Delau on his bed, and passing by the urethra a large quantity of blood. Urged by a violent desire to make water, he had at last withdrawn the bougie, but not without employing considerable force. This bougie presented, for three inches of its length (it was conical), a longitudinal groove of about half a line in depth, and about two lines in length. This was manifestly produced by a fragment of stone interposed between it and the walls of the canal. In withdrawing the bougie, the wax had accumulated behind the fragment, and had formed an obstacle which had augmented in thickness, in proportion to the traction.

After having examined the urethra, I found a large fragment about two inches from the meatus, where it was arrested. I extracted it after distending the canal.

I feared some unpleasant accident might follow, the urethral canal being, as I supposed, wounded, but nothing untoward occurred.

From this we may conclude, that in a calculous patient who has fragments remaining in his bladder, we ought never to introduce a waxen bougie. Such an accident as I have just described, might, in other patients, be attended with much more serious consequences than occurred in the cause of M. Delau.

Mr. P * *, of Paris, forty-eight years of age, had suffered from the stone for three years, he applied to a surgeon, who undertook to perform lithotrity, but though of undoubted skill, he was unsuccessful.

Supposing that the dilatation of the urethra was necessary as a preliminary step, he introduced bougies of increasing volume, which soon excited inflammation in the testicles, in the bladder, and in the hypogastric region, from which Mr. P * * was three months in recovering. At the end of this time, the patient consulted me. I sounded, and found, in an irritable, small, and contractile bladder, a stone which appeared of moderate size, but the form or volume of which I was not well able to appreciate, as the condition of the bladder prevented its being moved with facility. Some mucus was observed in the urine, the quantity of which deposited in the night, did not usually exceed two ounces.

Although I could not procure a very accurate knowledge of the stone, yet as I perceived it to be rather voluminous (about twelve or thirteen lines in diameter), I employed the "appareil évideur à forceps," with which, by the assistance of the "pince-servante," the calculus was seized with tolerable facility, and retained pretty firmly, but

on proceeding to excavate it, I soon found that it was not spherical, for, after several movements of the bow, the instrument stopped, and I perceived by the small quantity of powder passed after this first application of the instrument, that very little of the stone had been destroyed.

I then decided to employ the "perce-pierre," with which I restored the patient to health, but it was not until after nine other applications.*

Reflections.

This case proves that the introduction of large bougies, with the intention of dilating the urethra, is dangerous, and frequently much more so than the operation itself, for Mr. P * * was seriously ill during three months after the attempt at dilatation, but he had not the slightest febrile symptom during

* It is necessary to observe, that when I performed this operation at Paris, the only instruments I possessed were my "appareil évideur à forceps," and the "perce-pierre." I, at that time, employed the "appareil évideur," whenever the stone required several perforations by the "perce-pierre" before it gave way; for I supposed, that even in unfavourable cases, *i. e.* when the stone was *oval*, one attack of the "appareil évideur" would be equivalent to several attacks of the "perce-pierre." It was right, therefore, to choose the former, although it was constructed only for the destruction of spherical stones exceeding ten lines in diameter. Mr. P * *'s case was favourable for the employment of the "brise-coque," for the stone was somewhat flattened and smooth, and although destroyed by the "perce-pierre," this was effected with difficulty, and occupied a long time.

the whole of the period he remained under my care. I have expressed my opinion concerning the preparation of the urethra in the last chapter of this volume. Bougies should only be employed to lessen the sensitivity of the canal, and not to dilate it.

There is one more circumstance to notice in Mr. P * *'s case, that with the last fragments of the stone he passed portions of the end of a gum-elastic bougie; they were greenish, soft, and exactly similar to the two halves of a French-bean.

I operated on Mr. P * * in the presence of Drs. Dumeril, member of the Institute, Bigot, Sanson, Terrier, Fabre, and some other physicians and surgeons.

M. Besancenot, of Versailles, 52 years of age, well made, and of a good constitution, suffered for some years from the symptoms of stone, unconscious that he was the subject of this disease; but for some months the symptoms had become so aggravated that he consulted Dr. Souberbielle, who, on sounding, thought he felt several stones of considerable size, and proposed that he should submit to the operation of lithotomy: the patient refused to comply, and consulted me. I introduced the *recto-curvilinear sound*, and discovered a single stone of about fourteen lines in diameter, nearly round, smooth, and moving freely in a

bladder rather narrow and not very deep, but very contractile, irritable, and powerful; the urethra was of a moderate size, the urine muddy, and depositing a large quantity of mucous sediment. To destroy this stone I employed the "appareil évideur à forceps," with which, in one "séance," of eight or ten minutes in duration, I seized the stone, which I excavated with facility and the happiest result, as a considerable quantity of powder was voided, not only immediately, but during the four or five following days. Four applications of the "perce-pierre" were sufficient for the extraction of the fragments.

This operation was performed in the presence of Baron Thénard, member of the Institute, Dr. Noble, first physician at the Hospital of Versailles, Drs. Voisin and Pasquier, jun., the patient's son, and the greatest part of the pupils of the Hospital at Versailles.

Reflections.

With respect to the operation, this case is very simple, *i. e.* a stone nearly round, which was excavated by the "évideur à forceps" to a great extent, leaving little to be accomplished by the "perce-pierre;" but a circumstance somewhat curious occurred, which I think it right particularly to mention.

After each application of the instruments M.

Besancenot remained three or four days unable to pass a single drop of urine, and it was necessary to employ the catheter. Now this circumstance which, at first sight, may appear simple enough, is, nevertheless, of a nature to raise questions of some importance.

In fact M. Besancenot had an urethra of sufficient size, since it allowed the easy entrance of an instrument of three-and-a-half lines in diameter, his bladder was contractile and powerful, for if a catheter were introduced when it was full, the urine was expelled with violence; there was no stone either at the entrance of the neck or in the urethra, for I had taken care to free those parts; but notwithstanding all these circumstances, which were favourable to the expulsion of the urine, the patient could not void it, although he was pressed by the most urgent desire, and although the bladder contained a large quantity. What was the reason of this?

If we reflect on this remarkable, though not unfrequent occurrence, we shall perceive that it is owing to a *perversion of sensibility*, which prevents the contractile agents of the urinary organ from proceeding with a synchronous action to expel the fluid.

In order that a person may have the power of passing the urine, the muscles of *retention* must relax, and those of *expulsion* must contract. If

the muscles of retention, instead of relaxing, contract, it follows that there will be a struggle between these two agents of contraction; as long as the bladder is empty, no desire being excited, the patient is free from all painful sensation; but as soon as the urine is secreted and begins to distend the bladder, the struggle commences, and the advantage is always gained by the muscles of retention which are materially the stronger, and which have only a narrow entrance to govern.*

What was to be done for the relief of Mr. B.'s sufferings?—either to pass the catheter frequently, or to leave one in the bladder. I adopted the latter, and the patient was by these means relieved. In three or four days the synchronous action of the muscles was re-established, and the urine was voided naturally. Perhaps it may be as well to mention, that this circumstance interfered with the easy passage of the fragments, and

---

* It is necessary to observe that I am speaking only of a *perversion* and not of an *increase* of sensibility, which may or may not depend upon an inflammatory cause. In the case of *increased sensibility*, the bladder is continually emptying itself, and the desire continues although it contains no urine: when, on the contrary, a *perversion of sensibility* exists, all pain ceases as soon as the bladder be emptied.

This was the case with M. Besancenot. There are cases of retention of urine which are owing entirely to the *perversion* of which I speak.

that it was necessary to aid their evacuation by means of a sound with large eyes.*

This case is of a nature to support the physiological opinions I have published concerning the functions of the bladder.

M. Poterlet, fifty-two years of age, extremely irritable, of a lively imagination, sanguine temperament, and not very stout, had suffered pain in the kidnies about eighteen months; soon afterwards he perceived some disorder in the manner of voiding his urine, it sometimes stopped while flowing in a full current, sometimes the jet began with a twirling motion ("en tournoyant"), and terminated in the same manner; but at other times he could not expel it at all, notwithstanding the extreme desire he experienced.

Influenced by the inconvenience, rather than the pain he had suffered, he applied to Dr. Souberbielle, who sounded him, and recognising the existence of a foreign body, proposed lithotomy, to which M. Poterlet having refused to submit, he consulted me.

* Happily the action of the "évideur à forceps" having been complete, had reduced the greatest part of the stone to powder, and but few fragments remained to be voided; for having at that time only the sound with eyes, and not my present "sonde évacuatrice," I should, otherwise, have experienced much difficulty in curing this patient.

On sounding, I felt several stones which appeared small, hard, and moving freely in a moderately large bladder, but irritable and contractile in the extreme.

I made use of the "perce-pierre," and in five operations destroyed four or five small calculi, of four or five lines in diameter.

From this time the patient was entirely free from pain or any sort of inconvenience.

I operated upon M. Poterlet, in the presence of Drs. Pasquier, jun., Auvity, Souberbielle, and some other surgeons.

Reflections.

There is nothing very important to be said concerning the treatment of this patient, which only proves that in simple cases, and when the stones are small, the "perce-pierre" is an instrument by which a favourable result may be obtained with tolerable facility.

Two remarkable circumstances, however, occurred in M. Poterlet's case: the first is the excessive sensitivity of the bladder, which was so great, that when the instrument was moved for the purpose of searching for, and seizing the stone, the patient gave way to the most extraordinary motions; however, this did not present any considerable obstacle to the seizure of the calculus, and with respect to its destruction we had no difficulty; for as soon as it was seized, and the instrument at rest, the patient

was freed from painful sensations, and I was left at full liberty to place the instrument in the *fixed support*, and to destroy the stone by means of the bow.

The second circumstance, still more curious, in as much as it is more rare, for it is the only fact of the kind I have hitherto met with, is that, in order to introduce the instrument, I was obliged to lower its axis twenty-five degrees below the horizon.

M. Jules P***, a young man, 22 years of age, nervous in the highest degree, lively, self-willed, and of an impaired constitution, had suffered from the stone from the age of three years, at which time he was attacked with acute inflammation of the bladder, which at subsequent periods was renewed with violence.

The patient was recommended to me by Dr. Sarlandiere; on sounding, I found a stricture in the urethra, situated a few lines only from the neck of the bladder, which some other surgeons had been unable to overcome, when endeavouring, by means of the sound, to ascertain the cause of the numerous inflammations he had suffered.

After several attempts, I succeeded in introducing a gum-elastic bougie, of a line and a half in diameter, with which I distinctly felt a stone

at the neck of the organ, which situation it immediately quitted.

I began by dilating the canal to form a passage for my instruments: but the dilatation I obtained by means of bougies, only permitted the introduction of an instrument of two lines and a quarter in diameter; as this was not sufficient, I thought proper to cauterize the stricture, which was four lines in length.

In two applications of caustic, according to the method of Ducamp (from within outwards, and not from before backwards), I obtained, though with considerable difficulty, the possibility of introducing into the bladder a bougie of three lines in diameter; when introduced, it was firmly grasped by the canal.

I then sounded with the *recto-curvilinear instrument*, which hitherto I had been unable to pass. The patient presented an excessively large bladder; I could carry the beak of the sound upwards, to the right, to the left, and under the neck; the instrument, carried from the neck to the posterior part of the organ, marked a play of three inches;* the sensation produced scarcely

* The motion from before backwards, which enables me to estimate the distance existing between the neck and the opposite point, I call the *course* ("*la course*"). When I seize a calculus with any kind of forceps, and am desirous, before breaking it, to place the part of the instrument charged with the stone in the middle of the water, with

indicated the existence of a stone; and it was only after I had elevated the pelvis to forty-five degrees that the calculus came in contact with the convexity of the sound.

Notwithstanding the small calibre of the instrument I was obliged to employ, and the difficulty of feeling the stone, I operated with a simple "perce-pierre," by which, in thirteen or fourteen applications, the patient was enabled to pass the detritus of four or five small stones, brown, smooth, and translucent.

Reflections.

This case is remarkable in several respects. The first thing which strikes us is the extremely small size of the stones in a patient who for nineteen years had suffered from this disease. It is not always true, therefore, that around a foreign body placed in the bladder, salts, deposited by the urine, are continually accumulating, otherwise, in nineteen years, these stones would have acquired a larger volume; it may perhaps be said that they had not existed so long, and that the pain and inflammation with which the bladder had

---

which the bladder is filled; I ascertain by the *course* the situation of the two opposite points of the organ, in order to place the instrument in the middle point. There are many important things to be said concerning this *course*. We shall speak of it when considering the *operation*.

been affected were not caused by the stone; but this is by no means probable; besides other patients, and even in great number, have presented the singular phenomenon of stones existing for a long time in the urinary organ without increasing to any considerable size.

M. J. P * * * had a very decided stricture at the neck, although he had never had gonorrhœa. I attribute the one presented by this patient to the attacks of inflammation of the bladder, and which may have been propagated into the urethra to a greater or less extent; this cause of stricture has not, I believe, been indicated by authors. With respect to the stricture, this operation is remarkable; the cure was very slow, not less than fourteen applications of the "perce-pierre" being necessary. This may seem astonishing considering the small size of the stones, but the astonishment will cease on considering that the instrument employed was of a very small calibre, and consequently of but little power; that the strictured portion of the canal rendered the passage of the fragments very difficult, which made it necessary to reduce them to a very small size; that the bladder being very capacious, the fragments were disseminated over a large surface, thus rendering it difficult to find them; and, lastly, that the patient was so extremely sensitive as to preclude the possibility of prolonged applications of the instruments.

In conclusion I have to remark, that the patient during the whole course of his treatment suffered from no other febrile symptoms than those accompanying two attacks of inflammation of the testicles. This is the only accident of the kind that I have seen take place in the patients whom I have submitted to lithotrity; to account for these attacks, it is necessary also to observe, that I was unable to prevail on my young patient to be prudent. Before and after each operation he used to ride on horseback, nor did he, I believe, abstain from sexual excitement.

I operated on M. J. P * * * in the presence of his brother-in-law, Dr. Everard, Drs. Pasquier, jun., J. Sarlandière, and Terrier.

Madame de B * * *, thirty-three years of age, tall, of a sanguine temperament, and not very irritable, had suffered acute pain in the region of the kidnies about three years; during this period, she had, several times, at intervals of some months, passed white gravel, which she at first felt descending the ureters, and subsequently voided through the urethra.

For the last six months, however, the patient had been affected with a peculiar burning, and sometimes aching sensation in the bladder, accompanied by lumbar pain, weight at the lower part of the pelvis, and in the groins, and lastly, with

a frequent propensity to make water. If, when pressed by this desire, she endeavoured to obey it, her efforts were usually ineffectual, some drops of muddy urine only escaping with difficulty. But at other times it was expelled in a strong, full, and voluminous jet, which was often suddenly arrested, and the patient, notwitstanding all her efforts, could not evacuate the remainder.

These sufferings having become incessant, she determined to consult me.

The catheter enabled me to discover a stone at the entrance of the neck; which, as soon as the instrument was introduced, fell into the bladder. This organ appeared very large laterally, extremely deep, but presenting very little space (between an inch and-a-half, and two inches) from its inferior, to its superior part. On carrying the convexity of the sound to the *base* (bas-fond), I distinctly felt it divided into two nearly equal parts—a right and a left. This separation into two portions is produced by the uterus, which projecting, raises the middle portion of the bladder, and forms on each side a kind of groove. In the left groove, I found the stone, which appeared light, rough, of about eight or ten lines in diameter, and readily moved.

As the patient was expecting the appearance of the catamenia, I thought it right to wait a short time, hoping that, as soon as it should have taken place, the uterus would diminish in size: eight days afterwards I performed the operation.

Considering the small size of the calculus, I employed the "perce-pierre" with which, after some attempts, I made myself master of the stone, a single perforation sufficed to break it, and in the evening of the same day seven or eight large fragments were evacuated. From that time to the present, the patient has been free from all painful sensations in the bladder.

This operation was performed in the presence of Madame le Grand, principal Accoucheuse at the "Hospice de la Maternité," who very kindly honoured me with her assistance.

Reflections.

I quote the case of Madame de B * * * as an instance of lithotrity practised in the female, and because it is desirable to make some observations on this subject. With respect to the urethra, the female presents to the lithotritist difficulties, and facilities, which he does not meet with in the male. In the female the canal is short, it terminates in a plain surface, and not at the extremity of a projecting organ, as the penis in man. This disposition is productive of difficulty in the execution of two essential particulars; the first is that of retaining the water injected into the bladder, for we cannot compress the urethra of the female on the sound, as in the male; and the second is, that the introduction of the instrument cannot be quickly accomplished without some difficulty, in as much

as the extremity of the canal terminating in the vagina by a very inclined plane, causes the instrument to slip, and prevents its easy entrance. But if the female urethra presents difficulties in the above-named particulars, it presents also invaluable facilities with respect to its width; in fact, we can introduce voluminous instruments, and move them, with facility, in the bladder, in all directions; in consequence of this circumstance, the action of the instruments of lithotrity may be *extremely* energetic upon the stone in the female, and although the calculus be large, the cure may be rapid.

With respect to the bladder, the female presents some remarkable peculiarities: immediately behind the neck, the most inclined portion of the *base* is in the axis of the urethra, but more deeply in the organ, it will be found in the two grooves, to which I alluded in Madame de B * * *'s case, so that instead of being nearly certain of finding a small round stone in the axis of the instrument, we are obliged to seek it in these three places.

In this respect there is some advantage in seizing a large stone, for there is no necessity to seek it, as it can be immediately felt. This disposition of the bladder in the female, however, is variable in proportion to the varieties presented by the uterus in its volume, its more or less elevated position in the pelvis, and its inclination.

In Madame de B * * *'s case it was very low

down, and very large, but it diminished in size after the menstrual evacuation. When we are about to practise lithotrity in the female, if the period of this evacuation be approaching, I think it a good rule to wait until after its termination.

In the case of another lady whom I cured by lithotrity, the uterus being very much elevated, and of a small size, it did not deform the urinary organ; thus the action of *seizing* the stone was much more easy, but the action of *destroying* it was less so, in as much as the stone was not spherical.*

Mr. Seigner, 52 years of age, formerly a gilder, had suffered pain, characteristic of the stone, though in a moderate degree, for two years; for three or four months, however, this pain had increased, the desire to make water had become frequent, and the urine contained a considerable quantity of mucus.

Mr. Seigner consulted Dr. Breschet, surgeon of the Hôtel Dieu, who sounded the patient, found a moderate sized stone, and did me the honour to call me in to perform lithotrity, which

---

* This lady had a stone about the same size as Madame de B * * *. As the observations I should have to make on her case are nearly the same as those attached to Madame de B * * *'s case, the circumstances being very similar, I have not included it in my collection; there was this difference, however, that in this patient's case, two applications of the instruments were found necessary.

he had already seen me practise at the above-named hospital.

I sounded with my *recto-curvilinear instrument*, and found the urethra and bladder of a moderate size; the latter, however, was of greater width than depth, and presented some muscular columns; it was extremely sensitive and contractile, and the calculus was twelve or fifteen lines in diameter, and smooth; it gave a clear sound, and, although not moving freely, its situation was readily changed; it was placed exactly in front of the neck, a few lines from its opening. I applied the "appareil évideur à forceps," and in eight minutes the stone was seized and excavated.

In three applications of the "brise-coque," each of which lasted three or four minutes, the bladder was relieved from all the stone it contained; and each of these short applications caused the evacuation of a considerable quantity of fragments.

This operation was performed in the presence of Messrs. Magendie and De Blainville, members of the commission appointed by the Institute to examine my instruments, and many French and foreign physicians and surgeons.

Reflections.

This case is simple, but remarkable, inasmuch as it is the first in which the "brise-coque" was employed, and consequently the first time that the

system of crushing the stone has been effected by an agent worthy of it.*

Although at that time I had had very little practice in the management of the "brise-coque," since it was the first time I had ever used it, the members of the commission were fully convinced of the facility with which I seized and destroyed the fragments in the bladder; and also of the fact, that the time necessary for the completion of its action of seizing and breaking was infinitely shorter than that necessary for the accomplishment of these two actions by the "perce-pierre."

It was very fortunate for Mr. Seigner that I was enabled to make use, for comminuting the fragments in the shape of shells produced by the "évideur," of an instrument as rapid in its action as the "brise-coque," for I am of opinion, that without this rapidity his recovery would have been very much delayed, the patient being unable to support the presence of the instrument for more than two or three minutes without suffering the most painful sensations.

He was able to bear with tolerable facility the application of the "brise-coque," which requires only a few minutes for the production of a large

* The second time I made use of the "brise-coque" was in an operation performed publicly at the "Hospice de Perfectionnement," but it was a small stone, which was broken as soon as seized. This fact presents nothing instructive.

quantity of fragments and powder; but I doubt whether he could have sustained for fifteen or twenty minutes the presence of the "perce-pierre," which requires the whole of this time in order to produce a satisfactory result.

I should also add, that the members of the commission were so satisfied with this first trial of the "brise-coque," and found it so decisive, that it was one of the causes which determined them in concluding that my labours in lithotrity made me worthy of obtaining the surgical prize for the year 1828.

During the whole course of his treatment, Mr. Seigner did not suffer from any derangement of his general health.

Dr. Delamontagne, 58 years of age, for several years had laboured under an attack of the gravel, which at times caused acute suffering. He had passed small calculi, which, for the most part, were spherical, and continued to increase in size, as he voided them.

After continuing in this state for several years, Dr. Delamontagne perceived that the pain in his loins was accompanied by other pains, which he felt principally at the tip of the penis, and all along the urethra; he experienced a continual inclination to make water; walking became painful; and in a word, he complained of all those symptoms

which usually denote the existence of a stone in the bladder, and resolved to place himself under my care, in order to undergo the operation of lithotrity.

By means of the *recto-curvilinear sound*, I ascertained that the patient's urethra was large, but soft, spongy, and bleeding; that his bladder was soft, irregular, and contractile in the highest degree, so much so, that an ounce of water was no sooner injected, than it was expelled with force.

The calculus was not situated opposite the neck of the bladder, but to the right, it appeared immoveable, and at such a distance from the neck, that I could hardly touch it with the extremity of the *recto-curvilinear sound*. The violent contraction of the bladder prevented me from ascertaining, with any precision, its dimensions. By means of opiates, I succeeded in obtaining a less-contracted bladder, and injected a considerable quantity of water, which, however, was not long retained. I found by a second examination, that there was little space from the anterior to the posterior part of the bladder, but that it was very capacious laterally. The stone was generally situated to the right, but being very moveable when the bladder was distended, I could, with the curve of the sound, bring it to the centre of the organ; but the smallest movement dislodged it, and made it pass either to the right or to the left.

The stone appeared of a flattened oval shape,

rough in some parts, and of from fifteen to eighteen lines in diameter.

Notwithstanding the unfavourable circumstances arising from the irritable state, and disadvantageous structure of the bladder, I resolved, according to the advice of the Baron Dupuytren, Drs. Gaillard the patient's friend, and Leroy (D'Etiolle), whom I called into consultation, to attempt the operation; but I did not conceal from these gentlemen that I considered it almost impossible to seize a stone which so readily placed itself out of the axis of the instrument.

I performed the first operation with a simple "perce-pierre," of three lines and a half in diameter; the bladder received with facility an injection of six or seven ounces of water; but as soon as the instrument was introduced, the organ contracted so violently as to expel, between the external tube and the parietes of the urethra, the whole of the injection; the instrument then immediately became fixed, the branches were in contact with the coats of the bladder, and it was not until I had distended it, by injecting a fresh quantity of water through the canal of the instrument, that I succeeded in closing the forceps.*

In order to diminish the violent contraction of

* I have only added a canal through those instruments which, on account of the multiplicity of their branches, require this precaution.

the bladder, I desired the patient to take, for the second operation, a dose of opium, by which means I obtained a less contractile organ, and a considerable injection was retained. But when I had introduced and expanded the forceps, I could not so much as feel the calculus, which being placed in the lateral parts of the bladder, at a distance from the centre, was quite out of the reach of the instrument.

Two succeeding attempts were followed exactly by the same results; the stone was situated laterally, and although it sometimes came in contact with the forceps, this contact always took place outside the space comprised between the two expanded branches. M. Leroy (D'Etiolle), into whose hands I put the instrument, assured himself of the truth of my assertion, by making two attempts to seize the stone.

I therefore gave up the idea of submitting Dr. Delamontagne to the operation of lithotrity, for the means which the science *then* possessed were not applicable to his case; the patient, as the only alternative, had recourse to lithotomy. The Baron Dupuytrēn performed the operation with complete success, by means of his bilateral *lithotome*.

Reflections.

This is an unsuccessful case, and consequently more instructive than the others.

The first circumstance worthy of notice is the great advantage, or rather the absolute necessity, of having a canal carried through the instrument, which allows an injection to be made into the bladder, even whilst the forceps is in the organ; if I had not been able to accomplish this, I hardly know how I could have closed the instrument without becoming entangled in the folds of the bladder, and perhaps seriously injuring it. Dr. Delamontagne's case may therefore be said to prove sufficiently the importance of this addition.

This patient's bladder was, as I before remarked, very contractile; but I succeeded in overcoming this obstacle by means of opium, which I gave in large doses to the patient, who had been in the habit of taking it daily in considerable quantities, to ease his sufferings. By these means the patient's bladder, which before could not bear the injection of an ounce of water, retained with facility, and without causing the slightest pain, ten or twelve ounces; but this circumstance, although favourable in one respect, did not remedy the natural malformation of the bladder.

This organ was not more than from an inch and a half to two inches in its antero-posterior diameter, so that when the forceps was expanded it was almost immoveable, and was, as must easily be conceived, difficult to manœuvre, especially when the stone to be seized was placed, as it almost always was, in the lateral parts of the bladder; when the

instrument was drawn in the least towards the neck it entered immediately into the opening, or sort of funnel, which this part of the organ forms. In order to be master of a calculus situated as in the present case, an instrument must be employed which has its *centre of action* out of the axis of the tube contained in the urethra. Science is at present deficient in this respect.*

But to return to the opium, and to the favourable result which followed its application in this patient's case; I am led to conclude from this example, that, under particular circumstances, the stupifying effect it produces may be very advantageous, and facilitate considerably the performance of the operation of lithotrity; for if by its

* This case was written in the month of March, 1831. Such an instrument would be of the greatest importance, for since, to remedy the defects presented by the straight instruments, they must be constructed according to a certain curve, it follows that by this construction they would not only be peculiarly applicable in cases similar to that of Dr. Delamontagne, but would also be found of great service in treating those patients whose organs do not admit perfectly straight instruments. I once met with this circumstance in the case of Mr. D * * *, a man of science; I succeeded in breaking the entire calculus with the "évideur à forceps," by giving a small curve to its extremity;* but I could not comminute the fragments, for I then only had in my possession, besides the "évideur à forceps," the "perce-pierre," the construction of which does not allow a curve. Mr. D * * * was operated upon by lithotomy ten months afterwards, and died under the operation.

* The "capuchon" may be curved by lengthening it.

means the surgeon-lithotritist can obtain, for the space of fifteen or twenty minutes, a capacious dilatable bladder, free from contractions, I do not see why very large calculi should not be rapidly destroyed, if instruments of sufficient power are employed.

The only thing to be considered is, whether this advantage would not be purchased at the expense of the derangements and disorders which opiates may occasionally cause in the system. This subject requires meditation, and can only be answered by experience. The adoption of this treatment may perhaps lead to happy results, and extend the application of lithotrity.

This case also proves, that when attempts to perform the operation of lithotrity are made with method and prudence, they ameliorate the state of the patient, although they do not perfect his recovery; as a proof of this, Dr. Delamontagne, when he went from my hands, suffered much less, made water less frequently, and in much larger quantities, than when I first saw him; in short, he was in so favourable a condition, that the Baron Dupuytren consented to operate as soon as he was applied to.

In the last place, I would call attention to a circumstance which, although it may at first appear secondary, is, however, of some importance, and worthy of remark. Notwithstanding the difficulties which hindered me from ascertain-

ing very minutely the form and dimensions of the stone, I however drew a sketch of it on paper, and gave its diameter and shape before the Baron Dupuytren extracted it, and it was afterwards found to coincide precisely with my drawing.* This instance of being able to appreciate, by means of the sound, the shape and size of a calculus, proves that in the generality of cases it is possible to do so; and we are led to the important conclusion, that in lithotrity we may decide, *a priori*, what instrument can be employed with most advantage, and with the best chances of success.

Dr. Heron, 58 years old, after having been affected for some time with pain in the loins and along the ureters, experienced, on their cessation, all the symptoms of stone, which he suffered without seeking advice for more than a year. Fully aware of the dangers of lithotomy, he would not submit to the performance of this operation, but resolved to have recourse to lithotrity; and, for that purpose, placed himself under my care; he, however, first seriously meditated on the subject, and sought for every possible information which might assist him in forming his determination.

I sounded the patient carefully, and found the

* I have several times given these convincing proofs of the possibility of obtaining this preliminary knowledge of the stone.

urethra large, yielding, and moderately sensitive, the bladder was capacious, regular in its parietes, and of a good conformation ; it retained, with facility, an injection of ten or twelve ounces of water, was but little contractile, more than three inches broad, and from two and-a-half to three in depth. I felt several small calculi, which appeared to roll with facility.

Considering this a favourable case for the "perce-pierre," I employed this instrument, and in four applications completely relieved the patient's bladder from the stone it contained.

The different applications took place in the presence of Drs. Delaroche, Defermont, and other medical gentlemen.

Reflections.

Dr. Héron had three or four small uric-acid calculi, a good bladder, a very large urethra, and but little sensibility, at least during the operation ; this case is consequently simple and easy, but affords several important subjects for reflection.

If this patient experienced little or no pain during the performance of the operation, he was not so fortunate when it was terminated, for after every application of the instrument, he had an attack of fever and rigors, accompanied with nervous symptoms; he felt frequent inclinations to make water, but could not pass his urine without the assistance of a catheter. All these un-

favourable symptoms were caused by the presence of the fragments at the neck of the bladder, for although the patient's urethra was very capacious, and the stream of urine free and full, he found the greatest difficulty in passing his fragments; I was therefore obliged to obtain their expulsion by introducing a gum-elastic bougie with a large eye. I would not, however, by any means, generally recommend this practice, as it is attended with danger; for if a fragment were to become entangled in the eye of the catheter, the withdrawing of it might wound the urethra. I certainly brought out fragments from Dr. Héron's bladder without any accident; but this is owing to the very large capacity of the urethra, and the great care and prudence with which I proceeded; I should certainly not have adopted this plan under any other circumstances. This method of producing the evacuation of the fragments, besides being hazardous in its application, is very tedious and ineffectual, since it only admits of the expulsion of small pieces of stone. It was fortunate for Dr. Héron, that his bladder only contained a few small calculi, which were easily, and in a short time, reduced to small particles. I may here add, that since I have constructed the *evacuating sound*, a difficulty of this nature could be of no importance whatever, since I can at present, with equal facility, and without any risks, bring out from the bladder a large or a small quantity of fragments.

I will here lay down a very useful and important precept. In some cases the use of a catheter is resorted to, in order to draw off the urine; when this is done, *and there are fragments in the bladder*, it is absolutely necessary to have the means ready of immediately injecting water, for very frequently a fragment placed between the catheter and the parietes of the neck, is drawn out in the eye of the instrument, and might lacerate the passage; in an empty bladder it is almost impossible to push back a fragment, thus placed, and disentangle it from the catheter, and even if this be sometimes accomplished, there is no room in the empty bladder for the fragment to move away to some other spot, and it would, most likely, a second and third time retake exactly the same position with respect to the neck of the bladder, and the eye of the catheter; but by injecting a little water, the bladder is distended, and the pieces of calculus are disseminated in the organ, and are out of the reach of the catheter, which can then be withdrawn without danger.

Dr. Héron's case presented a circumstance which I had never yet observed; the operation was followed by a discharge from the urethra, which presented all the symptoms of an ordinary gonorrhœa. This I attributed to the frequent introductions of gum-elastic catheters, as well as to the fragments having occasionally remained some time in the urethra; at all events, this discharge,

of which I cannot exactly specify the duration, since I left France at that time, to come to London, is of little importance, and I even find it extraordinary that it is not more frequently met with after the manœuvres of lithotrity; sometimes, but rarely, I have observed a trifling discharge, which was always of short duration. I think this argument, founded on fact, may be opposed to the opinion of those persons who think that gonorrhœa may, in these cases, very frequently be attributed to mechanical excitement.

Mr. Cordier, a printer, 56 years of age, of a good constitution, after having experienced, during upwards of a year, difficulty in making water, and pain at the tip of the penis, especially after any bodily exercise, consulted Dr. Barbette. This medical gentleman having sounded the patient, and discovered a stone, confided the case to me.

By means of the *recto-curvilinear catheterism*, I found a moderately large urethra, possessing much rigidity in its parietes; a capacious, but powerfully contractile bladder, and especially at its base; a calculus, which I could not distinguish very accurately, from its being placed behind the neck, but which, as far as I could then estimate, appeared middling-sized, smooth, hard, and readily moved. The urine, which the pa-

tient was called upon to void very frequently, was sometimes pretty good and healthy, but often contained a considerable quantity of albumen.

Finding Mr. Cordier in many respects a good subject for lithotrity, I undertook his treatment, and employed a common "perce-pierre," supposing the calculus to be eight or ten lines in diameter; but when I had seized and perforated it three or four times, I found that it was much larger than I had expected; for after five "séances," during which I repeatedly seized and perforated the stone, it still remained entire; I was compelled to persevere in the employment of the "perce-pierre," notwithstanding my full conviction of its inefficient action and unsatisfactory results, for having commenced the operation with this instrument, I was under the necessity of continuing its applications.*

Although the stone was seized and attacked by the instrument several times in each "séance," the only result obtained, was the discharge of a

* When a calculus is perforated in several places, it cannot be acted upon by the "évideurs" (excavators), for the irregularities produced in the stone by the perforator *always* materially obstruct the eccentric action of the *excavating instrument*, and in most cases *completely* impede its progress, and consequently render this more rapid system of no avail. I might certainly have had recourse to the "virgule" in M. Cordier's case, but being at that time far less perfect than it is at present, I could not have employed it with advantage.

little powder and three or four small fragments; the patient's health was, however, very good, and his recovery appeared certain, although it was likely to be tedious; the bladder also being less irritable and contractile, was in a much more favourable state than it was when the patient first came under my care. Such was the condition of M. Cordier when I was obliged to abandon his treatment; for being about to leave Paris for London, I was necessarily compelled to give up the case, and placed the patient in the hands of my colleague, M. Leroy (D'Etiolle).

Ten months having elapsed, M. Leroy wrote to tell me that M. Cordier was well, but that the removal of his calculus had required eleven other applications of the "perce-pierre."

Reflections.

M. Cordier's case is useful, inasmuch as it shews the slowness and inefficiency of the action of the "perce-pierre;" and since it was precisely the want of power and the insufficiency of this instrument that induced me to undertake my labours in lithotrity, I feel myself justified in attaching some importance to a proof, taken from a surgical fact, to corroborate what a mere examination of the "perce-pierre" will render evident to all impartial judges. Never having myself employed this instrument alone, when the stone was twelve or fourteen lines in diameter, I cannot bring forward,

to prove my assertions, any of my own cases: I must, therefore, present that of M. Cordier, in which, being deceived as to the size of the calculus, I employed the "perce-pierre," and thus procured myself the example I was in want of.

I am the more ready to give this case, to support my opinion, from the cure not being due to me alone; for the patient having been placed under the care of so skilful an operator as M. Leroy (D'Etiolle), we may be fully persuaded that all the advantages which could be derived from the "perce-pierre" were turned to good account, and that, consequently, if the treatment proved long and difficult, we must attribute it solely to the instrument and to its defects.

When we come to reflect, that the calculus in M. Cordier's bladder, although only moderately voluminous, required sixteen applications of the "perce-pierre" for its extraction, we are naturally led to conclude that with this instrument cases must often terminate unfavourably, since patients are very often totally unable to undergo so frequent a repetition of the operation.

I refrain from seeking for further proofs, which, however, would be far more conclusive were I to state them. But any additional examples are unnecessary, since my readers will by this time be sufficiently familiarized with lithotrity to be able to analyse the means it possesses, and appreciate their worth.

Mr. Wattie, formerly a seaman, 64 years of age, was presented to me by Mr. White. In three applications of the "perce-pierre," which took place on the 24th and 30th July, and on the 20th August, 1829, two calculi, which might have been from six to eight lines in diameter, were comminuted and evacuated.

Reflections.

There was nothing very remarkable in this case, except a violent contraction of the bladder, which Mr. White and myself proved to be, as nearly as possible, equal to that which would result from a pressure of thirty-seven pounds on an animal's bladder distended with water. Mr. Wattie's case is, however, to myself rendered interesting, from his having been my first patient* in England, and

* It was at first my intention to give as long and detailed an account of the cases treated in England, as I have given of those which precede them; I even thought of adding to each case a minute description of the operative steps, but I saw that by thus expatiating I should render this part of the work far more voluminous than I intended it to be; and on considering that I had not yet given a full and clear description of the manœuvres of the lithotritic instruments, I felt convinced that these minutiæ would be imperfectly understood. The cases, as here related in a few words,

I feel much gratified in having this opportunity of expressing my obligation to Mr. White, for his liberality in confiding to my care the first case of stone treated in this country by the lithotritic process, and for thus laying the foundation of that success which has accompanied my subsequent progress.

The first operations were performed in the presence of Messrs. White, Edwards, Maitland, Gilbert, Ware, &c. &c.

MAJOR MOORE, of Dublin, 46 years of age, of a good constitution, and irritable temperament, was recommended to me by Messrs. Brodie and Crampton. His bladder contained a spherical calculus, composed of triple phosphate, of a soft substance, and about ten lines in diameter, which a surgeon of distinction had unsuccessfully sought to extract with a pair of curved forceps.*

---

fully answer the end for which I publish them, which is, as I before remarked in the introduction, *to prove that the instruments have been employed with success in the living subject.*

* Several of the patients upon whom I have operated had, previously to their confiding themselves to my care, unsuccessfully sought to have their calculi extracted with the curved forceps, the ingenious author of which is too well known for me to think it necessary to name him.

In two applications of the "perce-pierre" the calculus was reduced to fragments and powder,

---

This is a useful and valuable invention, since, by its means, patients have been cured of the stone, without being obliged to run the risks of the cutting process; it is, however, of much less importance since the discovery of lithotrity; for although it was employed with advantage when patients could only have their stones removed by submitting to the operation of lithotomy, now that it can be compared to lithotrity, we find it attended with many serious risks, of which I will select the three most important:—

1. By employing the forceps the surgeon is in danger of lacerating the urethra, and of producing urinary fistulæ.

2. The employment of the forceps often requires that an incision should be made, in order to extract a calculus, which from its size sometimes cannot be drawn out, and remains entangled in the urethra; and when this takes place near the neck of the bladder, the extraction of the calculus differs little from the operation of lithotomy.

3. When an incision has been made in the perineum, which in itself is not unaccompanied with danger, and when, as is often the case, there still remain several calculi in the bladder, this operation is of little avail; for the portion of the urethra which was cut into in order to extract the stone, necessarily contracts more or less, and thus presents an obstacle to the introduction of the instruments of lithotrity; the patient will consequently be compelled, as the only alternative, to undergo lithotomy, in order to have the stone extracted which remains in his bladder.

Thus we see that the application of the curved forceps is attended with danger, and that it can only be completely successful when the calculus is very small, and even then, notwithstanding the skill of the operators, it is with difficulty seized and extracted; and further, searching for the stone always fatigues the patient much more than several operations with an instrument of lithotrity. Another dis-

which the patient voided with facility. The symptoms of stone then entirely disappeared, and Major Moore has since enjoyed good health.

Reflections.

The only remarkable circumstance in this case is, that the stone, when once forced into the cervix of the bladder by the urine, was retained there for a considerable length of time, on account of its physical properties; this threw the patient into a continual state of spasm, and produced a catarrh of the bladder, which however ceased entirely when the stone was extracted.

Major Moore was operated on in the presence of Dr. Boyton, Mr. Pierrepoint, and several of the Major's friends, who were not medical gentlemen.

ADMIRAL * * *, of Exeter, 64 years of age, was placed under my care by Mr. White. He had for several years been afflicted with the symptoms of stone in the bladder; I examined him with the *recto-curvilinear sound*, and distinctly felt a calculus, which was about fifteen lines in diameter; it ap-

advantage is that the surgeon can never foresee, whether or no it will be necessary to make an incision in the perineum, not knowing whether he has grasped a stone with projecting angles, or one too large to pass through the urethra.

peared spherical, composed of uric acid, and very hard. The prostate gland was enlarged to such a degree, that it obstructed the free passage of the urine, which was thick, and deposited a considerable quantity of purulent mucus; the patient felt a desire to make water nearly every half hour, and the expulsion of the urine was attended with acute pain; the bladder was very uneven, and intersected with septa; and lastly, beneath the enlarged prostate there existed a considerable pouch, in which the stone was frequently lodged. Notwithstanding these disadvantages, I thought it right and prudent to undertake the treatment of this case by lithotrity. Considering the size of the stone, I first employed a "trois branches à virgule," and afterwards comminuted the fragments with a simple "perce-pierre," having only one hooked extremity, on account of the irregularity of the bladder. As the cavity situated under the cervix, hindered the stone or fragments from being either felt or seized, whilst the patient was in the horizontal posture, it was frequently found necessary to operate on him in an inclined position, which was easily obtained by means of the *rectangular bed.* The case before us proves the importance of this position. The Admiral, on account of the enlarged prostate, being unable to make water in a full stream, it followed, that he could only pass the powder,

and no fragments; this circumstance induced me to construct an *evacuating sound*, with which the patient was enabled to void large pieces of calculi without any difficulty or danger.

The Admiral left London in perfect health in February, but wrote me a letter about five months after his arrival at Exeter, stating that his former sufferings were renewed. I desired him to come to London immediately, and having sounded him, discovered nearly as much stone in his bladder as there was before I operated upon him. I immediately proceeded to comminute the newly formed calculus, and brought out the fragments in the same manner as before. The Admiral naturally thought that a fragment of the first stone, having been left in the bladder, had formed the nucleus of another calculous concretion; I could not help being of the same opinion, although Mr. White and myself had sounded the patient three or four times after the last operation, without finding the smallest remnant of calculus; but a careful examination of the fragments of the second stone, convinced both the patient and myself, that it was quite a new formation, for it was white, and purely composed of triple phosphate, whilst the first one was red, and entirely formed of uric acid: if a fragment of this stone had remained in the bladder, it would immediately have been recognized.

Reflections.

This patient will most likely be again afflicted with stone, since, in his case, it forms so rapidly. I warned him of it before he left, in order that he might not allow the calculus to attain any magnitude. The Admiral can only be completely cured, when, by a process of nature, his constitution changes; for as, from a sound state of health, he became subject to form calculous concretions, so, from a tendency to make stone, he may recover his primitive constitution: he has therefore every reason to hope for a perfect recovery, if, as I suppose, the disease has been removed from the prostate and the bladder in consequence of the extraction of the stones.

The Admiral's case, above all others, forcibly proves the importance of lithotrity. The patient being naturally disposed to form vesical calculi, must repeatedly have undergone the operation of lithotomy, and every time have endangered his life, had he not submitted to lithotrity and thus obtained relief, without exposing himself to such serious risks.

This patient was operated upon in the presence of Sir Anthony Carlisle, and Messrs. White, Bransby Cooper, Copland Hutchison, &c. &c. &c.

Mr. Duncan, of Worcester, 50 years of age, was recommended to me by Messrs. Green and Pierrepoint. He had been suffering from the symptoms of stone for more than two years, and on examining his bladder, I discovered a calculus, which, with the sound, I estimated at about an inch in diameter: it was red, smooth, and composed of uric acid. The urine deposited a considerable quantity of mucus, and often stopped suddenly when the patient was voiding it. Mr. Duncan seldom suffered severely unless he took too much exercise on foot or on horseback, which produced excessive pain, mostly accompanied by bloody urine, and more frequent and urgent inclinations to void it.

This operation was commenced with a "trois branches à virgule," with which the calculus was fractured, and the fragments were afterwards comminuted with a "perce-pierre."

Reflections.

The only thing worth noticing in this case is the extreme sensibility of the bladder, which I sought to subdue by introducing bougies daily for some time before the operation. This preparatory treatment had the desired effect; for although the patient suffered rather more than is usually the case, the sensations never amounted to absolute pain, not even during the application of

the instruments. Another remarkable circumstance in this case is the immediate cessation of a blennorrhœa, which existed at the same time as, and was, without doubt, a consequence of, the stone; for as soon as it was extracted the blennorrhœa disappeared.

Mr. Duncan was operated upon in the presence of Messrs. Green, Brodie, Pierrepoint, White, Edwards, Whymper, Eve, &c. &c.

Mr. Sutcliffe, a farmer, residing at Thortle Bowers, Yorkshire, 55 years of age, having read an account of Mr. Wattie's case in the medical journals, came to London, and confided himself to my care. I carefully examined the patient's bladder with the *recto-curvilinear sound*, and felt distinctly two oval calculi which appeared smooth and were disposed in alternate layers of phosphate of lime and uric acid; they were about twenty lines in length, and from ten to twelve in thickness; the bladder was capacious, but very contractile, and the urethra was large. Notwithstanding the size of the calculi, I considered this a suitable case for lithotrity.

I first attacked the stones with a simple "percepierre," in order to weaken them by a few perforations, so that the "brise-coque" might after wards be employed with greater effect. It is to be regretted, in this case, that I had not at

that time in my possession a "trois branches à virgule" sufficiently large to fill the patient's urethra, for with this instrument, in one operation, I should have reduced the stone to a favourable state for the action of the "brise-coque," which the "perce-pierre" required three or four applications to accomplish. In eight "séances," however, the stones in Mr. Sutcliffe's bladder were sufficiently reduced to be easily expelled, and the patient was completely relieved from every painful sensation.

Reflections.

This case clearly proves the importance of the "brise-coque," which acts much more powerfully and rapidly than the "perce-pierre;" after every application of the "brise-coque," the patient voided a large quantity of powder and fragments, and the applications of this instrument were of much shorter duration, and, according to the patient, much less painful than those of "perce-pierre."

I will in the last place direct your attention to the size of the calculi, as a subject worthy of remark; the detritus, when collected, weighed an ounce and a half, besides what was accidentally lost or passed at the patient's stools.

I operated on Mr. Sutcliffe in the presence of Messrs. Earle, Brookes, Green, White, Babington, J. C. Powell, Partridge, Edwards, and many other gentlemen of the profession.

Mr. Rodgers, of Limerick, 60 years of age, was recommended to me by Mr. Green. He had been suffering from the stone for more than a year, or, what is more correct, he had, about a year before I sounded him, observed, for the first time, the symptoms caused by stone in the bladder. The recto-curvilinear catheterism enabled me to discover a calculus, which might have been from ten to twelve lines in diameter.

I commenced the operation with the "perce-pierre," and acted twice upon the stone, with little or no effect; on account of its smoothness and flattened shape, it escaped from the grasp of the branches as soon as the perforator was rotated by the drill-bow. This circumstance induced me to employ the "brise-coque," with which, in one operation, the stone was broken; and in another, the portions of calculi which remained, were reduced to powder, and fragments sufficiently small to be carried out with the stream of urine.

Reflections.

A fact worthy of notice in this case is, that with the "brise-coque" was accomplished in two "séances," of short duration, what the "perce-pierre" could, perhaps, not have performed at all; or at least, not without a far greater number of applications, attended with danger.

This case might have been successfully treated by means of the "perce-pierre" alone, but only after having repeatedly submitted the calculus to the action of the instrument; by dint of chipping the stone, and breaking off small pieces, it might at last, perhaps, have been comminuted, after an exceedingly long and painful treatment. In this case, therefore, the "brise-coque" proved essentially useful. The orifice of the patient's urethra was very much contracted; I was consequently obliged to make an incision in the little membranous fold which produces this contraction.*

Messrs. Green, White, Brodie, and Dr. Boyton, were present at the operations performed upon Mr. Rodgers.

* We seldom find it necessary to make this preliminary incision, but when the opening of the urethra is contracted, it is better to have recourse to these means, which are not at all, or but slightly painful, than to distend the passage.

Besides this contraction of the urethra, which is natural, there are accidental ones, known by the name of strictures, which impede the easy introduction of the instruments; these are treated before the operation is commenced. We have in our possession instruments suitably adapted to remove strictures, by means of which we have been enabled to introduce through canals, which could at first only receive the smallest sized bougies, instruments of three or four lines in diameter.

We will not, however, in this work, enter into any details on this subject, which is of sufficient importance to form matter enough for special consideration.

Mr. Goldsmith, solicitor, about 30 years of age, residing at Watford, was presented to me by Mr. Bransby Cooper, who, having sounded the patient and discovered a stone, advised him to have recourse to lithotrity, which mode of treatment Mr. B. Cooper thought advantageous, on account of the age of the patient, his good constitution, and the favourable state of his bladder. The smallness of the stones in Mr. Goldsmith's bladder induced me to employ the "perce-pierre."

With this instrument two or three small calculi were immediately seized and destroyed; but I frequently observed that one of them, although secured by the branches, escaped from their grasp as soon as the drill was put into action. This clearly indicated that the stone was flat, and I resolved to destroy it with the "brise-coque," which immediately seized and crushed it.

From this time every symptom indicative of stone in the bladder disappeared, and the patient recovered his health.

Reflections.

A circumstance worthy of notice in this case is, that Mr. Goldsmith, having some business to transact which required his attendance, went to

Watford between the second and third "séances." While he was at home, a fragment became fixed in the urethra, and harassed the patient considerably; he returned to London in a much worse state than when he left, and I immediately proceeded to push the fragment back into the bladder, by employing means which secure the urethra from every sort of danger. Having thus relieved him from the pain he felt, I continued the operations, and reduced the stone to fragments, which were immediately voided.

The shape of the flat calculus deserves attention: it consisted of two small stones, each of which resembled a large lentil; they were joined together by their edges, so that, although each one separately was only six lines in diameter, they together formed an elongated, smooth, flat stone, which the "perce-pierre" seized with difficulty, and could not maintain with sufficient firmness for the perforator to act upon it. The patient passed a fragment which corresponded to the part where these two calculi were united.

Mr. Goldsmith was operated upon in the presence of Messrs. Bransby Cooper, White, Warren, Biggs my pupil, &c.

A Greenwich pensioner, 48 years of age, consulted Mr. Dobson, surgeon of the hospital, for a blennorrhœa. This gentleman having sounded

the patient, in order to discover what might be the cause of a discharge, for which no reason could be assigned, found a large stone in the bladder, and did me the honour to send for me and place the patient under my care.

The calculus being spherical and very large, I thought it right to commence the operation with the apparatus known by the name of "évideur à forceps." With this instrument, and the "pince-servante," which then only served as an *indicator*, the calculus was immediately seized, and firmly secured; for about ten minutes the eccentric excavator acted upon its interior, but this was not sufficient to reduce it to fragments. The stone being composed of uric acid, and disposed in layers of different density, though they were all exceedingly hard, did not yield so readily to the action of the excavator, as those calculi which are less hard, and, above all, of a more regular grain; all the centre was however wasted away by the action of the instrument.

The two following operations were performed with the "trois-branches à virgule;" with this instrument a large quantity of detritus was obtained, although the stone was only attacked four times.

The patient, after the application of these instruments, voided many fragments, and a great deal of powder; the fourth operation, however, convinced me that there still remained in his bladder a large

compact mass of stone, in which there were several openings formed by the "virgule," and a central excavation resulting from the action of the "évideur à forceps."

The excavating instruments being at present of little avail against the excessive hardness of this calculus, I thought that by *percussion* I should more speedily determine the fracture of this mass, which, from being hollow, appeared likely to yield more readily to these means, than to any other. The *excavator* could not now act, on account of the irregular interior of the stone, and the *perforator* of the "perce-pierre" was useless, from its tendency to fall into the numerous holes which had previously been made, and from thence into the hollow centre, where there was no substance for it to act upon.

I consequently thought it expedient to endeavour to break this hard concave mass by percussion, and for this purpose communicated the shock of a hammer to the stone by means of a drill, placed between three very strong branches: a few strokes sufficed to reduce the stone to fragments.

The "pierce-pierre" was employed twice, to reduce the fragments into smaller pieces, which were afterwards speedily comminuted with the "brise-coque."

Reflections.

This case is remarkable for many reasons. In the first place, having undertaken to operate upon this patient publicly at an hospital, I thought it my duty to apply, successively, all the instruments of lithotrity which I consider applicable, and which I have proved to be so by *facts*, in order to shew the action of each one. I employed the "perce-pierre," and clearly proved that, although a pretty good instrument in certain cases, it possessed many imperfections, to obviate which, I invented the excavating instruments, and the "brise-coque;" the immense advantage of these instruments, as much with respect to seizing as destroying entire calculi and fragments, was clearly pointed out; and lastly, the rapid action and great power of the *excavators* was as evident, as the necessity of their assistance was undeniable.

In a word, this case was converted into a sort of study, by which all the medical gentlemen who were present at the different operations, were enabled to form an idea of the means employed in lithotrity for curing patients of the stone without incision. The importance of being able to raise the pelvis, as is easily accomplished with the *rectangular bed*, was clearly demonstrated; it was seen that when the patient was lying on a horizontal plane, it was sometimes nearly impossible to seize the fragments, and especially the entire stone,

but by changing the position, this was rendered easy, and gave much less pain. The "support fixe" afforded general satisfaction; every one allowed it to be, not only of incontestible utility, but absolutely necessary, since without it the system of excavation could not be employed.

This is the first case in which percussion, with a hammer, was ever brought into action on the shells of calculi, which the excavators could not reduce to fragments.

The gentlemen who saw this mode of proceeding, could not but think it rather extraordinary, and perhaps hazardous, to break calculi in the bladder with a hammer, but after witnessing the fact, they were also unanimous in their opinion, that it was not only safely practicable, but that in many cases it might be of the utmost importance. From this patient's safe recovery then we may date an improvement in lithotrity.

When the pensioner applied to Mr. Dobson, it was to consult him for a discharge which had lasted some time; but the patient himself had not the slightest suspicion of the presence of a stone in his bladder, having never experienced the pains, nor observed the symptoms, which generally accompany its formation; we may therefore conclude, that in this case, the calculus was discovered almost by chance. This circumstance is curious, but not so uncommon as is in general imagined, and it deserves attention—for it proves

that lithotrity will frequently relieve patients afflicted with large stones, although it has been said, that when this mode of operating shall be generally known there will only be small calculi to destroy; but it is evident that they must sometimes become large, since persons can retain them a long time in their bladder, without being aware of their presence. I have also to add, that this patient frequently indulged in drinking spirituous liquors during his treatment; this leads us to the conclusion, that lithotrity is accompanied with very little danger, since, by its means, patients may be relieved from a large quantity of stone, and be restored to health, notwithstanding these deviations from a proper diet.

This patient was operated upon publicly at the Greenwich Hospital, in the presence of a great number of medical gentlemen, and under the auspices of Mr. Dobson, to whom I express my warmest thanks, for having afforded me an opportunity of making known in England a useful method of curing a disease, and for having contributed in so liberal and friendly a manner to my success.

Sir ***, Bart., residing in London, after having during a year experienced the ordinary symptoms which indicate the existence of a calculus in the bladder, consulted Mr. Brodie, who discovered a stone, and thinking this a fit case for lithotrity,

did me the honour to call me into consultation, and placed Sir *** under my care.

Having examined the patient's bladder with the *recto-curvilinear sound*, I discovered a spherical calculus, of about ten lines in diameter, hard, smooth, and easily displaced. Judging that it was composed of uric acid, in concentric layers, and of a friable nature, from the sound produced when it came in contact with the instrument, I employed the "perce-pierre." In three applications of this instrument the calculus was reduced to powder and fragments sufficiently small to be voided by the urethra, and the patient felt nothing more of the symptoms of stone in the bladder.

Reflections.

The case of Sir *** is simple; it consisted of a spherical, uric acid calculus, the two most favourable conditions for allowing the patient to be speedily relieved; its spherical shape facilitates its seizure with the "perce-pierre," and its chemical composition renders its destruction easy by means of the drill.

This operation was, however, attended with difficulty on account of the violent contraction of the bladder. I must here make mention of a circumstance of some importance, which proves how little inconvenience patients sometimes feel from the operation of lithotrity. Sir *** was cured of the stone without his family being aware that he

was treated for so serious a disease, and even now they continue ignorant of this fact; for the patient never communicated to them the nature of his malady before he was treated, and was able to retain the same reserve during his treatment; for after every operation he returned home on foot, in the same manner as he came, and presided at his own table in the midst of his friends. I mention this circumstance, because it is curious that a person successfully treated for the stone, should have been all the while living with his family, and that they should have been ignorant of what was going forward. Every patient in the same favourable condition as Sir ***, and under the same circumstances, will suffer as little; for the most part, they walk to my house to undergo the operation, and return home in the same manner. Wr. Wattie, my first patient, 64 years of age, came two or three times from Chelsea to Parliament Street, where he was operated on, and walked back again directly after the operation.

Mr. Brodie was present at the operations performed on Sir ***, and my pupil Mr. Biggs.

Mr. Castle, Surgeon to the County Clare Infirmary, 62 years of age, after having suffered several years, consulted Mr. Crampton; this gentleman discovered a stone with the sound, and advised the patient to come to London and con-

fide himself to my care; with this request Mr. Castle immediately complied, and left Dublin for London, where he arrived in June, in a weak, suffering state.

I sounded the patient, and discovered a stone, which was oval, not very moveable, and composed of uric acid; it persisted in remaining behind the neck of the bladder, where an accurate examination could not be made without difficulty. The urine was catarrhous, and its expulsion was attended with considerable pain.

The calculus was first attacked with the "perce-pierre," which I thought might be employed with advantage in this case; but the stone being smooth, and flatter than it had first appeared to be, escaped from the branches as soon as the drill pressed upon it. In five applications of this instrument the stone was not once perforated, a little powder was scraped from its outside, and many small pieces were broken off, one of which evidently corresponded to the edge of a flat stone, but no other result was obtained.

This was sufficient proof that it was necessary to employ the "brise coque;" for I soon perceived, that to destroy a calculus of this shape, with the "perce-pierre" would require a longer and more painful treatment than the patient could bear.

In three applications of the "brise-coque," a stone, which had not yielded to the numerous

attempts and imperfect action of the "perce-pierre," was reduced to fragments and powder, and completely evacuated.

Reflections.

This case is important, because Mr. Castle, who is a surgeon, capable of judging in medical affairs, confided himself to my care, in order to be treated by my method. Let such a choice, then, call the attention of my readers to that system, which, in the present case, has proved so clearly the insufficiency of the "perce-pierre," and the importance of the "brise-coque;" for let it be remarked that this latter instrument was only employed when I had discovered the almost utter impossibility of reducing the stone with the "perce-pierre." This circumstance may lead us to the conclusion, that when the science is better established, cures may be effected more rapidly; for the treatment may be rendered shorter, by all the time which is at present wasted in ascertaining what instrument may be used with most advantage. If ever I meet with a case similar to that of Mr. Castle's, I should immediately attack the stone with the "brise-coque," and by so doing, I should completely relieve the patient's bladder in three applications, each of which would last four or five minutes, instead of subjecting him to the slow and useless attempts of the "perce-pierre."

Mr. Castle was operated upon at my house, in

the presence of Drs. Hume, Clendinning, M. Hamilton, my pupil Mr. Biggs, and several other gentlemen.

Mr. Archer, 52 years of age, feeling the inconveniences and pain caused by the presence of stone in the bladder, consulted M. Heelis, who having sounded him, indistinctly felt a hard substance, but the sensation was so imperfect and momentary, that he could say nothing positive on the nature or cause of the patient's malady, although he was firmly of opinion that the bladder contained a stone. In this state of uncertainty M. Heelis was kind enough to apply to me; I found the patient in pretty good health, but the urine was occasionally thick, and deposited a little mucus.

I made a minute and careful examination with the sound, but experienced the same difficulty in distinctly feeling the stone as Mr. Heelis. In the same manner as this gentleman, I once or twice thought my sound had come in contact with a calculus, but the sensation was so imperfect and transient, that I could then give no definitive opinion with respect to the case. The bladder was irregular, covered with cells, and during its contractions it was intersected by muscular columns, between which the stone might conceal itself, and be thus placed beyond the reach of the sound, at

least until the contractions partly ceased. However, taking into consideration the symptoms of stone, which in Mr. Archer's case were well characterised, and the sensations which had been felt, however imperfectly, and being at the same time fully persuaded that the introduction of an instrument could not be productive of the slightest inconvenience, I thought it advisable to operate; for it was evident that if a stone did exist, it must have been small, and would be immediately seized and comminuted. By introducing an instrument to examine the bladder, I should not only be taking the most active measures to ascertain with certainty the cause of Mr. Archer's sufferings, and the extent of his complaint, but should also be employing the most rapid and effectual means to relieve the patient.

I put this plan into execution, and employed a "perce-pierre" with only one hook, on account of the inequalities of the bladder. Notwithstanding these inequalities, a fungous and varicose state of the cervix, and a high degree of contraction, I succeeded in grasping a small round uric-acid stone, which was immediately reduced to fragments and powder.

Reflections.

This case is interesting for various reasons; it proves that a calculus cannot always be detected

by means of catheterism, and that an instrument of lithotrity is not only better adapted than a sound to find a calculus, but that a surgeon may, in some cases, convert a simple examination into an immediate operation.

Mr. Archer's case also deserves attention, from his having had a bladder with a varicose neck, which swelled to such a degree after the introduction of the instrument, that it presented an almost insurmountable obstacle to the expulsion of the urine. For four or five days the patient could not pass a drop of water without the assistance of a catheter, which was introduced daily, and sometimes more frequently, to empty the bladder: these introductions had the twofold advantage of bringing out the water, and enabling the patient to expel his fragments immediately, and without the least difficulty. In the course of a few days, he was able to make water in a full stream, but for a fortnight after the operation his urine continued to deposit a little glairy mucus.

I operated on Mr. Archer in the presence of Mr. Heelis, and my pupil Mr. Biggs.

Captain Armstrong, from Banagher, 64 years of age, after having suffered for about two years and a half, consulted Mr. Crampton, who, having discovered a stone, was kind enough to give him

the same advice as he had given to Mr. Rodgers and Major Moore—to come to London, and place himself under my care.

The captain came immediately, I sounded him, and discovered a large, smooth, oval stone, which could be readily displaced, but did not roll; the bladder was capacious, but contractile, the urethra was large, and the patient's health was pretty good, with the exception that he ate with little or no appetite.

Two days after the examination, I found Captain Armstrong in a favourable condition to undergo the operation, which I performed with the "trois branches à virgule," as being the most appropriate instrument I then possessed for breaking oval stones of considerable magnitude.

In the first operation, the "virgule" acted twice upon the stone, and produced much detritus; I also discovered that there were two calculi in the patient's bladder, for whilst one was held fast by the instrument, another was distinctly felt.

The second operation was performed with the same instrument: the oval stone which had been before attacked was again seized, and the "virgule," acting in the very centre, reduced it to fragments, some of which were immediately seized and comminuted.

I practised the third "séance" with the "trois branches à virgule," hoping to destroy the stone which still remained entire, and which I con-

sidered of an oval shape. In trying to accomplish this, several fragments were seized and broken; but when I grasped the entire calculus, the more special object of my operations, it escaped from the branches as soon as the "mandrin à virgule" was rotated. This circumstance led me to conclude that the stone was flatter than I had expected, and consequently could not be firmly maintained, or effectually acted upon with the three-branched instruments; I was so much the more confirmed in this opinion, from the patient having voided a fragment detached from the edge of the stone, in one of the former imperfect attacks; this fragment evidently corresponded to a flat calculus, and I soon perceived that the "brise-coque" was the only instrument which could be advantageously employed in this case. The result of my attempt with this instrument affords the most convincing proof of the justice of my conclusions, for in three applications of four minutes each, a calculus, which had been attacked ineffectually by all the other instruments, was speedily reduced to fragments and powder with the "brise-coque."

After the second application of the "brise-coque," I waited a few days to see if Captain Armstrong would experience any sensations indicative of the presence of a fragment in the bladder. Observing that the stream of water was still rather irregular, I examined the patient with

a "perce-pierre" which had but one hooked branch, and apprehended a small fragment, which was crushed and voided immediately.

From this time the patient was as completely free from every symptom of stone, as he was from pain and uneasiness of any sort, and soon afterwards returned to Dublin.

Reflections.

The quantity of stone in this patient's bladder, and the rapidity with which he was relieved of it, render this case interesting; it also shews the comparative advantage of two different instruments: the "brise-coque" and the "trois branches à virgule;" the latter was applied with success in the case of an oval stone, but proved to be very unfavourable when used in relation to a flat one, which was, on the contrary, instantly broken by the "brise-coque."

Captain Armstrong, although of an advanced age, always came to my house on foot to be operated upon, and returned in the same manner after the operation.

The operations were performed in the presence of Sir Astley Cooper, Messrs. White, Key, Bransby Cooper, Copland Hutchinson, Propert, Sayer, Biggs my pupil, &c. &c.

Mr. S***, of Chatham, 61 years of age, after suffering for more than three years, consulted Mr. White, who recommended him to apply to me, and wished me to undertake his treatment, although the unfavourable state of the patient raised some doubts in his mind concerning the success of lithotrity, if attempted in such a case.

In fact, Mr. S***, notwithstanding a pretty good state of health, presented a complication of untoward symptoms, which rendered his cure by these means uncertain. Besides two inguinal herniæ, and a hydrocele, his bladder threw many serious and additional obstacles in the way. For a long time he had laboured under a considerable hæmaturia; his bladder, which was badly conformed, and overrun with partitions, was lined with a soft spongy membrane, which bled at the mere contact of a sound; his prostate was large, his urine deposited a large quantity of muco-purulent matter, and was often bloody; he could not make water without experiencing great pain, and the stream was small and without force, so that there was no reason to expect that he would be able to expel the fragments by the expulsive power of the bladder.

Notwithstanding all these difficulties, I thought that lithotrity might be applied with advantage,

for although the stones were numerous they were small, and I was so much the more ready to entertain this opinion, from a perfect persuasion that such an accumulation of unfavourable circumstances must render the operation of lithotomy still more doubtful and dangerous.

I therefore undertook Mr. S***'s case, and employed a "perce-pierre" with only one hook, on account of the irregularity of the bladder. In a few applications of this instrument, and with the assistance of the "brise-coque," we had the satisfaction not only to enable the patient to evacuate all the stone which his bladder contained, but to see the urine become clear, and retained in larger quantities; the desire to make water was evidently less frequently felt, less violent, and accompanied with little or no pain; the membrane was even and resisting, and did not bleed at the introduction of a sound; the hæmaturia ceased entirely, and, in a word, there was a cessation of all the unfavourable symptoms which had before existed.

The stream of urine, although considerably better, is not even now quite as it should be: this depends on the enlargement of the prostate gland.

Reflections.

Mr. S***'s case is remarkable for the happy change effected in his urinary organs, which were

in so deplorable a state before the operation; it is also remarkable on account of the numerous difficulties which attended the manœuvres during the operation; for, before the instruments could be applied, it was necessary to open the hydrocele; during their application we were obliged to compress the two hernia; the calculi concealed themselves in the lateral pouches which existed in this patient's bladder; it was therefore necessary to find them out, and place them, with the sound, on a smooth surface, before attempting to grasp them with the instrument. The bladder being lined with a soft fungous membrane, it was very difficult to seize the stones, and more especially the fragments, without coming in close contact with this membrane, in the folds of which the fragments were entangled. Finally, since the patient did not expel his urine with sufficient force to pass the fragments of stone naturally, it was necessary to bring the detritus from the bladder mechanically, by means of the *evacuating sound.* Lithotrity, however, surmounted all these obstacles, and has proved successful in restoring to a favourable state, a patient on whom lithotomy could not have been practised without the greatest risk of its proving fatal.

Mr. S*** is now in the enjoyment of good general health, and his bladder remains in the same favourable condition, with the exception that there is now and then a gravelly formation of triple

phosphate, which is, for the most part, voided with the urine; but if the gravel be too large to pass through the urethra, I immediately comminute it. This tendency to form stone will very probably cease in a short time, either, as I before remarked, from a change in the disposition of the patient, or else by means of suitable draughts and injections.

I operated upon Mr. S*** in the presence of Messrs. White, Gillett, Coleman, Martin, Biggs my pupil, &c. &c.

THE REVEREND ***, 61 years of age, had experienced, during a year, difficulty in making water, pain after walking, and other symptoms of stone in the bladder; he could not bear the motion of a coach, and was still less able to ride on horseback. In this state he consulted Mr. Brodie, who, suspecting the cause of the patient's sufferings, sounded him, and discovered a calculus. Mr. Brodie considering this a favourable case for lithotrity, recommended me to Mr. ***, who confided himself to my care, and consented to submit to the operation of lithotrity.

Mr. ***'s health, in general, was pretty fair; but he was very irritable, and had daily an attack of rigors accompanied with fever, which usually lasted the greater part of the night. The urine was thick and oleaginous; it deposited a purulent

sediment, and the patient could not void it with any force. By means of the sound, calculous substance was distinctly felt in the bladder; but I could not then positively affirm whether it consisted of one or more stones. The sound it produced, and the facility with which it was moved, indicated, however, that it was small and spherical.

It was thought advisable to postpone operating, until the patient should be completely free from the attacks of fever and spasm to which he had been subject. In about six days I found M. C** in a favourable state to undergo the operation, and was about to perform it, when he complained of considerable pain in one of his testicles. I examined it, and found it very much inflamed, without being able to assign any reason for its being in such a state. The patient was treated for this inflammation, which extended to the epidermis and spermatic chord; and when I had obtained Mr. Brodie's opinion to corroborate my own, that Mr. *** was sufficiently recovered to submit to the operation, I proceeded to the destruction of the stone.

"The "perce-pierre" was employed, but with this modification—that, instead of turning the drill by means of a bow, I determined to break the stone by percussion. To that effect I struck the perforator with a hammer, and thus communicated the shock to the calculus, which was

reduced to powder, and into such small fragments, that they were all voided, notwithstanding the small degree of force with which the patient made water. In two "séances" I destroyed five or six calculi, of four or five lines in diameter; and in the last, combined the use of the hammer with that of the bow, by which means I rendered the action of the instrument more complete and rapid. A third examination convinced us that the bladder was free from stone; and a total absence of all unfavourable symptoms confirmed us in this opinion, and gave us the satisfaction of pronouncing the patient completely restored; he has ever since enjoyed good health.

Reflections.

Many circumstances render this case interesting. Mr. ***, who was feverish and uncommonly nervous before he submitted to the operation, was relieved from this unfavourable state immediately after the first application of the instruments, the mere contact of which improved his state of health to such a degree, that the day after the last "séance," I surprised my patient jumping from a chair, to ascertain whether any unpleasant sensations remained.

I must also remark that the violent inflammation of the testicle, which shewed itself before the operation was commenced, never once appeared

during or between the applications of the instruments; and yet, the testicle having been so lately inflamed, must necessarily have had a greater tendency to have become so again. This circumstance is a convincing proof that, when the operation of lithotrity is well performed, it does not, as some have asserted, produce inflammation of these organs.

In Mr. ***'s case, the employment of a hammer to destroy small stones, also deserves attention. Its application was attended with great advantage; for it not only comminutes the calculi more rapidly, but more completely, especially when its action is combined with that of the drill-bow. This is very frequently an object of importance, and was particularly so in the case before us, since the patient could not have voided large fragments, from the want of force in the expulsion of his urine.

Mr. *** was operated upon in the presence of Messrs. Brodie, White, Propert, Drs. Gregory and Locock, Mr. Biggs my pupil, &c. &c.

Mr. Taylor, a farmer, 48 years of age, came to me in the month of July, with a written recommendation from M. Brodie, who wished me to sound the patient, but stated, at the same time, in his letter, that it was a case of very large calculus,

which he thought might be beyond the power of my instruments of lithotrity.

The patient informed me, that he had suffered from the stone for upwards of 20 years, and that he had been subject to violent nephritic attacks, which were usually followed by the expulsion of small calculi, *per urethram;* he said that he frequently felt great pain in his bladder, and had recently laboured under an acute inflammation of that organ, accompanied with fever, a considerable catarrh of the bladder, and an utter impossibility to make water without the assistance of a catheter.

With the sound I discovered a very large, immoveable, and apparently spherical calculus; the bladder was contracted, and expelled immediately the water which was injected, and the patient passed, at short intervals, a small quantity of thick, offensive urine.

This examination was performed during the excessive heat, and, for various reasons, it was thought advisable to send the patient home for a time. Not having been able to estimate, with precision, the shape and size of the calculus, on account of the violent contraction of the bladder, and the acute pain the patient suffered when the stone was moved in the least, we could, then, only conclude, that this vesical concretion was very large, without being able to give the patient any other details on his case.

Mr. Taylor was recommended to follow an antiphlogistic treatment, and to return to London, when the violence of his sufferings should have in some measure abated, and when his bladder might be in a state to contain a sufficient quantity of water to allow the stone free movement.

The patient went home, but notwithstanding all the means employed to ease his pain, and restore his bladder to a more favourable condition, he soon fell into the same state as before, and experienced all the symptoms of an acute inflammation of that organ; this attack lasted about a month; after which, his health gradually improved, and in December he came to London in a better state than when I first saw him.

His sufferings were much alleviated, and the operation of sounding was much less painful; the urine was voided less frequently, and in larger quantities, although it still continued to deposit, at times, a considerable quantity of glairy mucus. His bladder now retained a larger quantity of fluid, and the stone could be readily displaced; it appeared round, rough, very large, but not, however, out of proportion to the means I possessed for breaking and pulverizing it.

I at first declined operating upon this patient, on considering that the mere presence of the calculus in his bladder, without any other cause, had several times caused violent inflammation of that organ; for I thought it almost inevitable not to

produce the same result by mechanical causes, such as the presence of the numerous fragments which must necessarily be produced by the action of the instruments on such a voluminous calculus.* But seeing that Mr. Taylor feared the knife exceedingly, and was unwilling to submit to its application, I departed from my first resolution, and begged Messrs. Key, White, Bransby Cooper, Copland Hutchison, and Green, to come and sound the patient, and enable me, with their valuable assistance, to form a final determination.

These gentlemen kindly acquiesced in my request, and having examined the patient, without difficulty recognized the size of the stone, and the difficulties of the case, which arose principally from the tendency of the bladder to inflame; but notwithstanding these difficulties, they were of opinion, that the treatment of the patient might advantageously be undertaken by lithotrity, as he then enjoyed a favourable state of health.

Quite of the opinion of these gentlemen, and desirous to employ every means at all likely to

* At that time I did not pursue the plan of bringing out the fragments by means of an *evacuating sound*, in all cases; this idea only occurred to me when I had perfected this sound sufficiently to find it more advantageous, in almost every case, to enable the patient to evacuate the fragments by its assistance, rather than leaving this to be performed by the natural contractions of the bladder.

relive a patient who refused to be treated by any other means, I undertook the case, and submitted Mr. Taylor, in the course of a few days, to the action of the "évideur à forceps."

In the first application of this instrument, which was made in the presence of Sir Astley Cooper and Messrs. Green, Brodie, White, Copland Hutchison, and my pupil, I observed, that the stone did not come before the expanded forceps, as is always the case, when there is a single round calculus in the bladder; by means of the "pince-servante" I, however, discovered, that a small stone was brought within the grasp of the branches, and it was instantly broken, by merely pressing it between them.

The first operation terminated here, without producing the effect anticipated—that of seizing and excavating the large calculus which had been distinctly felt.

The following day Mr. Taylor voided one half of the little calculus which had been broken: it must have been of an oblong shape, from eight to ten lines in length, and from four to five in breadth.

In a second application of the same instrument, made before Sir Astley Cooper and Mr. White, the stone being situated immediately before the expanded forceps, was seized and secured. Having ascertained, by means of the "pince servante," which then only served as *indicator*, that the cal-

culus was firmly fixed, I prepared to act upon it, and in eight or ten minutes perforated and excavated it.

Although the perforation which I made in the stone clearly proved that it did not exceed an inch in diameter, I still conceived that I had excavated and partly broken the large calculus which had been discovered with the sound; for I thought I might have been mistaken in the opinion which I had formed of its shape, on account of the difficulties which resulted from the contracted state of the bladder. Having sounded the patient two days afterwards, I found, in effect, that the calculus, instead of being nearly spherical, as I had imagined, was more of an oblong shape, and had been seized by one of its extremities, which was excavated, and was of a smaller diameter than the rest of the stone.

The patient voided a large quantity of powder after this operation, but not a single fragment, which led me to conclude that the calculus was either not broken, but only hollowed out, or that it was reduced to two or three pieces, too large to pass through the urethra.

Eight or nine days after this second operation, however, which was as gentle as the previous one, and as inoffensive, as respects the organs, the patient felt more pain in making water, the urine deposited a larger quantity of mucus, and he was attacked with a slow fever, followed by symptoms

of congestion of the lungs, which lasted about a month, when the patient died.

Reflections.

This case, being a failure, excites our interest, and may prove more instructive than those which precede.

The termination of this case was certainly to me a matter of surprise, when I considered, that only two applications of the instrument had been made, and that they were both very gentle, and gave the patient little pain, since he got up immediately after their termination, and walked home; further, with the "évideur à forceps," scarcely any movements are required to seize the stone. I was also surprised when I reflected that both operations were short, not lasting above nine or ten minutes, and that the patient, during the whole time, hardly made the slightest complaint. Finally, the consequences which followed these attempts were to me as unexpected as surprising, after having observed, and rendered evident to the professional gentlemen who honoured me with their presence, that the bladder was entirely free from injury, by the clearness of the water, which, after each operation, I brought out from the bladder.

A *post-mortem* examination could alone remove my uncertainty, and throw some light upon a circumstance so extraordinary and uncommon. It

was clear that there must have been some accidental and independent cause to produce so sudden and rapid a dissolution, and this cause was immediately discovered by Mr. White, who had the kindness to open and examine the body himself. The kidnies were found to be six or seven times their natural size; they were decomposed, and formed of a soft, pulpy substance, which, when compressed between two fingers, exudated pure pus, in the same manner as a sponge would, which had been imbibed in this matter; the calicæ, and especially the one on the left, were enormously dilated, and admitted a doubled fist; the ureters were also very much distended, and received a tube of four lines in diameter; they were filled with pus of a slimy, glutinous nature, which proceeded from the kidnies, and exactly resembled the matter deposited by the patient's urine during his life; there was no formation of stone either in the kidnies or ureters. The extremity of the ureters which communicate with the bladder, being loaded with this same slimy matter, proved that it proceeded from the kidnies, and not from the bladder; this organ was contracted, but its parietes were even, and did not present the smallest mark of any laceration or injury caused by the operation. A calculus was found of two inches in length, sixteen lines in breadth, and thirteen or fourteen in thickness. At about a third of its longest diameter, there was a perforation of about

four lines, which penetrated entirely through the stone; the space between the two openings of the perforation was excavated to an extent of about ten lines, which rendered this extremity of the calculus friable, and well adapted to the action and power of the "brise-coque." We were surprised at not finding in the patient's bladder the remainder of the little calculus, of which he had voided a portion after the first application of the "évideur à forceps;" but we concluded, that it had escaped his observation, either when he made water in the streets, or at his stools. There was still a considerable quantity of easily-detached powder adhering to the exterior of the calculus.

Although this case was unsuccessful, it nevertheless furnishes us with many important facts. In the first place it gave convincing proofs of the excavating power of the "évideur à forceps," and of the rapidity with which this instrument renders friable a stone which before was hard and compact; it also proved how truly this instrument indicates the shape of the calculus, for I had correctly stated that I was acting upon a rounded-oval-shaped stone, but not quite spherical as I had been led to believe from the simple examination with the sound.

Finally, the *post mortem* examination rendered it evident, that M. Taylor had for a very long time been labouring under an organic disease of the

kidnies, which would not only, in all probability, have prevented his cure by any means whatever, but must shortly have caused his death, independent of any other coinciding circumstance to determine it.

Although the decease of this patient was satisfactorily accounted for on opening the body, I will not omit remarking, for the good of those patients who are now afflicted with the stone, that this unsuccessful termination is also and more particularly owing to the want of courage and resolution in M. Taylor, who, instead of having recourse to lithotomy on the first appearance of the symptoms of stone, preferred enduring, for upwards of twenty years, all the pain and uneasiness it caused, and thus allowed the disease to gain ground and affect other organs. If lithotrity had been known at that early period, M. Taylor would probably have submitted to its performance, when the formation of the calculus had just commenced, and he would, by so doing, have avoided those sufferings which have embittered half his life; he would then have been almost certainly restored to health, for at that time his kidnies would not have been in a disorganised state, resulting from repeated inflammations; his bladder would not have been contracted and inflamed; and, lastly, his calculus would not have been enlarged to such a degree.

M. Isaac Browne, 58 years of age, experienced at different intervals, during eight or nine months, more or less violent attacks of pain in the loins, which were soon followed by all the symptoms of stone in the bladder: painful sensations at the tip of the penis, complete and partial stoppages in the stream of urine, frequent inclinations to make water, acute pain during and after its expulsion, and finally uneasiness and suffering after walking or any sort of active bodily exercise.

The patient's sufferings were not, however, very severe during the first two years of his disease, and the attacks were mostly of short duration; but during the two succeeding years, they became more and more acute and unbearable. M. Browne had recourse to various methods of obtaining relief, suggested to him by experience: such as, sitting with his legs in the air, &c.; and this position, although seldom resorted to by other patients, proved very beneficial to M. Browne.

After remaining for about four years in an almost continual state of pain and uneasiness, experiencing all the symptoms of stone, without having any suspicion of the cause from which they proceeded, the patient accidentally met with a little pamphlet, containing a collection of the first cases of lithotrity treated by me in England; these cases are followed by a descrip-

tion of the *first symptoms of calculus in the bladder*, the perusal of which gave M. Browne correct ideas as to his state, and convinced him that all that he had and did suffer could only be caused by the presence of a stone in his bladder.

With this persuasion he came to London, and consulted me. I examined him with the *curvilinear sound*; but notwithstanding a most careful and minute examination, I had not the slightest sensation of having come in contact with any hard substance; the urethra was of moderate size, and with regular parietes, the bladder was very large, of considerable depth below the neck, contractile, but dilatable by means of an injection; it presented also, during its contraction, muscular columns; the urine deposited a small quantity of mucus.

Rather surprised that, after a disease of four years' standing, I should have experienced so much difficulty in finding the stone, which I felt almost confident did exist, I resolved to renew my researches, fully convinced that if the bladder contained a calculus it was of small dimensions.

For the second examination I placed the patient on the *rectangular bed*, which allowed me to elevate the pelvis; by these means, after some searching I suddenly felt a momentary sensation of having touched a stone with the sound; this almost entirely convinced me of the presence of a calculus, which the well-marked symptoms had already

made me consider so highly probable. By inclining the bed, I probably made the stone roll towards the posterior part of the bladder, where I imperfectly felt it with the convexity of the sound; but notwithstanding all my subsequent attempts I could not obtain a renewal of the sensation; this I attributed to the facility with which the little stone rolled about in the patient's capacious bladder.

Although this second examination did not afford me an absolute certainty that a calculus existed, I, however, considered the slight sensation I had experienced with the sound, added to the symptoms of stone so well characterised, motives sufficiently indicative and convincing, to authorize the introduction of an instrument of lithotrity, which, having the power of *seizing*, could give more accurate ideas concerning the case than could be possibly conveyed by the *recto-curvilinear sound*, which only possesses the property of *feeling*.

In effect, having introduced the "brise-coque," a small calculus of seven or eight lines in diameter was instantly seized, and as readily comminuted; a great portion of the detritus was extracted in the spoon-shaped extremity of the branches, and the remainder I brought out from the bladder by means of the "sonde évacuatrice," which I introduced immediately after having withdrawn the instrument. We thus had ample proof of the presence of a stone, on which the examination

with the sound had left us in doubt and uncertainty.

From this time the sufferings with which M. Browne had been afflicted for upwards of four years, completely disappeared, and this eagerly-desired relief was obtained in one single operation of three or four minutes' duration, and which, according to the patient's own account, was attended with little pain.

Reflections.

The most remarkable circumstance in M. Browne's case is the small size of a calculus which had, in all probability, existed for upwards of four years in the bladder. When the patient consulted me and gave me the particulars of his disease, I concluded that I should discover a voluminous calculus of fifteen or twenty lines in diameter; but the result of the catheterism having convinced me of the small quantity of stone contained in the bladder, I could not account for this unusual circumstance: but perceiving some analogy between M. Browne's case and one which I had previously treated, I still persisted in my opinion that there was more or less calculous concretion in his bladder; which induced me to continue the examination, and introduce the instrument.

To explain the reason why a calculus remains

so long in the bladder without enlarging, is a subject yet to be studied.

This case also leads us to conclude that a stone which cannot be detected with the sound, may be seized and destroyed with a lithotritic forceps; the reason of this is, that a very small stone avoids the sound, by rolling away from before it, and only communicates to the hand of the surgeon an almost imperceptible shock, whilst the forceps by seizing this little body, and hindering it from rolling away, when once comprised between the branches, affords the surgeon a most convincing and unanswerable proof, either that there is or is not a stone.

Finally, M. Browne, having carefully read the little pamphlet in which I have described the symptoms of stone in the bladder, and having by this perusal, ascertained the true cause of the sufferings which he before had not been able to account for, from this sole motive formed the resolution to come to London and place himself under my care.

It is to be regretted that he did not avoid so much suffering, by sooner seeking advice and being apprised of his real state; but we must also consider it a happy circumstance, that owing to something peculiar in his constitution, the stone should not have enlarged, and that the bladder should not have become seriously affected.

M. Messenger, 72 years old, residing at Petersham, experienced, three years ago, violent pain in the loins, and such excessive weakness, that when once seated, he could not rise without the greatest difficulty. About this time he frequently voided gravel varying in size, sometimes without pain, and at other times with the most excruciating suffering.

The pains in the loins soon ceased, and were succeeded by symptoms of stone in the bladder. His sufferings were not at first very severe, but they afterwards increased to such a degree, that during the paroxysms to which he was subject, he would sometimes writhe in agony and utter piercing cries; the slightest exertion was followed by acute pain and bloody urine.

He continued in this deplorable state for upwards of two years, at which time, through the means of a friend of his, who was acquainted with the success which had attended the operation of lithotrity, he was recommended to me, and resolved, notwithstanding his advanced age, to undergo the operation as I practised it.

I found, with the *recto-curvilinear sound*, that the patient had a large but soft and fungus urethra, a capacious bladder, regular in its fundus, but presenting, anteriorly, a loose spongy surface,

which could be easily depressed with the sound. I frequently struck against a hard substance, but I found that when it approached the soft surface before alluded to, it rolled with difficulty, and seemed to penetrate into it when I pressed upon it with the sound. At the back part of the bladder, which was even, I distinctly felt a calculus, middling sized and very moveable. The bladder easily retained a large injection, and was of moderate sensibility; the urine was albuminous, and often deeply tinged with blood, when the patient walked a little, or exercised himself in any active manner.

I employed for the first operation a "percepierre," with which a stone of six or seven lines in diameter was immediately seized and broken; I also discovered that there were several calculi in the bladder, for whilst one was retained in the forceps I felt others moving in the organ. For two or three minutes I continued comminuting the pieces of the stone which I had first broken, and the patient immediately voided, through a gum-elastic catheter, with which I injected his bladder, a considerable quantity of powder and small fragments. For three successive days M. Messenger only passed powder, but no fragments, although their grating against a bougie, when it was introduced, proved that there were many in the bladder.

Three days after the first operation, I found

M. Messenger in a favourable state to undergo a second application of an instrument, and I employed the "brise-coque," which more rapidly and effectually accomplishes the pulverization of small stones and fragments than the "perce-pierre." In the course of two or three minutes I laid hold of several fagments, and small calculi, which were instantly crushed.

Having perceived that the patient's bladder did not possess sufficient expulsive power to eject the fragments, I thought it necessary to employ the "sonde évacuatrice," with which I immediately brought away a large quantity of detritus, and also filled the "magazin" (magazine) with stone, which I took out when the sound was withdrawn.*

Two days after this operation I sounded M. Messenger, and felt two or three small fragments, which I directly seized and crushed, with the "brise-coque," and the greater part of which was withdrawn in the bill-shaped extremities of the branches. I then injected the bladder by means

* The "magazin" of the "sonde évacuatrice," is a sort of cavity or receptacle at its extremity, into which I force the fragments, entangled in the eye of the sound, or in any part of the tube, on account of their being too large to pass out. By means of this "magazin," I can, without taking the sound from the bladder, bring out at once three, four, or five, large fragments, without giving the patient the fatigue which must necessarily result from withdrawing and reintroducing the sound for each fragment.

of the *evacuating sound*, and brought out the small quantity of detritus which remained.

Reflections.

This operation is highly in favour of lithotrity, not only on account of the age of the patient, but also because he was, as may be expected, deficient in moral energy; for a simple conversation which took place in his hearing concerning the means employed for performing the operation of lithotomy, produced considerable uneasiness and feverish excitement, which, however, only lasted a single night, but which leads us to conclude that the patient could neither have gone through the preparations, nor have sustained the consequences of this serious operation. He, however, courageously bore the application of the instruments of lithotrity, without any other inconvenience than a slight attack of rigors after each one, which was always of short duration.

M. Messenger, on account of his advanced age, presented, as do almost all old men, the disadvantage of not being able to void a single fragment of any size, although the urethra was capacious; this circumstance was particularly unfavourable in this patient, for it is most probable that he could not have gone through more operations than were required to break the stones which his bladder contained. Had I not been in possession of my *evacuating sound*, several more opera-

tions would have been rendered necessary to reduce the fragments to powder, and such pieces as he could have voided.

This case, therefore, especially proves the great importance of the *evacuating sound*, not only because the inability of the patient to pass his fragments rendered its employment absolutely necessary, but also because its application was witnessed by several distinguished surgeons, among whom I shall only mention Sir Astley Cooper, who approved of this instrument, and expressed his satisfaction.

In fact, I can prove that, by means of the sound evacuatrice, it is possible to obtain mechanically the evacuation of numerous fragments in a very short time. Now, if we consider that the natural expulsion of the detritus is often tedious, and sometimes causes more pain and uneasiness to the patient than the application of the instruments themselves, and finally that some patients are totally unable to void a single fragment, and cannot consequently be treated by lithotrity, unless suitable means be employed for bringing away the detritus, we shall readily be convinced of the great importance of this newly constructed sound.

I operated upon M. Messenger in the presence of Sir Astley Cooper, M. Wakefield, M. George Julius, M. Propert, M. Anderson, Dr. Byron Bradley, Dr. Negri, Dr. Nehrar, M. Biggs my pupil, &c. &c.

Mr. K***, of Liverpool, aged 68, had experienced, for nearly three years, symptoms denoting the presence of a stone in the bladder, and these sensations had followed those which indicated the formation of gravel in the kidnies, and its descent by the ureters. Sometimes this patient enjoyed an almost complete cessation of pain, but at other times he was a prey to such acute sufferings, that he was unable to walk, and he often spent sleepless nights; these periods also were marked by frequent inclinations to void the urine, which was catarrhal, and often tinged with blood. Mr. K*** remained in this state three years without submitting to catheterism, and merely resorting to medicamented drinks, which were entirely without effect. In fine, having affairs at London, he left his residence, and on his arrival, profiting by the opportunity, he consulted Mr. Brodie, who sounded him, and ascertaining the presence of a stone, did me the honour of sending him to me, the 3d of May, 1831.

I examined him, and found a narrow canal, especially at the meatus, and a bladder excessively contractile, in which I could with difficulty inject an ounce of water. A stone was in the organ, but it appeared immoveable, and I could grate upon it with the curve of the sound without de-

ranging it; the sensibility was excessive, the urine was troubled, furnishing an albuminous sediment, and was not expelled in a stream, but fell by its own weight.

Besides the stone, Mr. K*** had a fistula, which opened externally by two sinuses, one by the internal fold of the right thigh, the other in the same situation to the left. The opening of the sinus, on the right thigh, had been closed for some time: it was the first which had formed a fistulous opening, and had existed for three years. Finally, the patient had an inguinal hernia on the right side.

Before commencing the operation, I directed my efforts to the enlargement of the urethra and bladder, in order to facilitate the introduction of the instruments and their necessary development.

I made an incision at the meatus, which enabled me to introduce an instrument of three lines and a quarter; and I directed an opiate injection to be made in the rectum, by which means the bladder was sufficiently dilated to receive six or seven ounces of water.

This effected, I introduced a simple "perce-pierre," because I believed the stone to be small (perhaps eight or ten lines), but with this instrument introduced, and opened, notwithstanding the precaution I had taken not to expand the branches far, I found that it had no play whatever from before backwards. Nevertheless, I felt the

stone, but on depressing the "perce-pierre" in order to seize it, the branches embraced a voluminous body, soft, but sufficiently elastic to repel the drill, which I pressed lightly upon it. The instrument, the branches of which I had drawn together with precaution, was immoveable.

From these unequivocal signs, I discovered a malformation of the "basfond" of the bladder, of which a part was raised in front of the neck, and I withdrew the instrument, that I might examine this peculiarity more maturely by means of the sound. With this instrument, to which I had given a very slight curvature towards its extremity, I fully ascertained this vicious conformation. In front of the neck was a part higher than the rest, and of this I was convinced by the absolute impossibility of turning downwards the curved part of the instrument, which, being only from eight to ten lines, ought, if the bladder had been well formed, to have passed easily either upwards or downwards; at the posterior part of the organ, this movement of rotation was possible. With the extremity of the curve laterally, and turned to the right side, I felt the stone but imperfectly; the curve of the sound employed was not sufficiently long; this stone, as far as I could judge, was immoveable.

It was evident if there existed, as my sounding proved to me, an eminence of the "basfond" in the direction of the axis of the straight instrument, it

would be extremely difficult for grasping in this patient with an instrument, the centre of whose seizing power was in this axis, since two difficulties extremely difficult to overcome presented themselves,—first, the calculus, [illegible] position, would naturally be placed to one side; and, secondly, the prominent part of the "bas-fond" would necessarily be grasped by the expanded branches of an instrument [illegible] the principle of branches diverging laterally [illegible] *from a straight tube*.

It was a case, then, to which this kind of instrument was inapplicable; but before deciding it to be such, I thought it right to make a second trial with a simple "pince-pierre." This experiment was followed by precisely the same result; a soft and immoveable mass was interposed between the branches, and the instrument became as completely unmanageable as in the first instance.

Fortunately for the patient, I had some time previous had an instrument constructed on a principle, by which *the centre of its seizing action* was no longer placed in the axis of the instrument, and which, consequently, was in accordance with the difficulty this malformation presented—this I employed.

Having introduced it, the stone was found situated on the right side of the bladder. It was instantly seized, and as quickly broken, by means of a percussion, which I directed imme-

diately upon it, by the use of a hammer; much powder and some fragments were immediately expelled.

Three succeeding applications of the same instrument sufficed to reduce the fragments of this stone to a sufficiently small size, for their easy passage through a hollow sound.

These operations were performed in the presence of Mr. Biggs my pupil, and Dr. Negri, who assisted at the last application. Mr. Brodie, whom I asked each time, was unable to attend.

Reflections.

This case is interesting, for it affords the proof that a great difficulty has been overcome, and that lithotrity may count henceforth analogous cases within its scope—that is to say, those cases where the stone and fragments, being by an accidental circumstance placed laterally, are no longer within the reach of an instrument, in which the *centre of action* is in the axis of a straight tube, which supports several diverging branches.

In the case of Mr. K***, this circumstance, as we have seen, was owing to a prominence in front of the neck of the bladder, but I have before seen it arise from another cause, and that in a patient whom I could not then cure for want of an instrument constructed on a different principle. The new instrument, to which the recovery of Mr. K*** is due, is then, I trust, a good and useful inven-

tions in which [illegible] [illegible] although [illegible] it was employed under favourable [illegible] circumstances [illegible] applicable in ordinary cases and [illegible] the force of lithotrity. [illegible] to introduce in this science [illegible] with which we may break up stones by means of percussion with a hammer, is, without doubt, introducing the most rapid system of destruction, for *percussion* is even more rapid than the *crushing process*, which is performed by the "brise-coque."

To represent this system, which I have already employed with the "*perce-pierre*," I only required a proper agent, and I venture to hope I have found it, as experience will, I trust, afterwards prove. The case of Mr. K*** already speaks something in its favour.

To return to the principal peculiarities of this case, it appears to me that they admit of ready explanation. For three years Mr. K*** had had a fistula; now we see that fistulous sinuses are surrounded sometimes by condensed cellular membrane, especially when the sinus takes place in cellular tissue, for then nature requires this fibrous organization to prevent infiltration; it may have happened, then, that, in this case, the fistulous opening from the rectum may have taken place in the part of the intestine which corresponds to the inferior part of the neck of the bladder, and that

in the cellular tissue, which exists in this part a mass of fibrous tissue may have been formed, which would project into the organ. This, as will be observed, is only a supposition, but it appears reasonable, and likely to give some idea of the influence a fistula may exercise over the success of an operation of lithotrity.

THE END.

EXPLANATION

OF

THE PLATES.

EXPLANATION

OF

THE PLATES.

EXPLANATION OF THE PLATES.

FIRST PLATE.

This Plate represents, in two distinct squares, the " Perce-Pierre," and the " Trois Branches à Virgule."

" PERCE-PIERRE."

1st Fig.—The " perce-pierre," closed (Reduced to one half).

2nd Fig.—The " perce-pierre," open (Reduced to one half).

8th Fig.—The extremity of the " perce-pierre," closed (its full size).

9th. Fig.—The extremity of the " perce-pierre," open (its full size).

3d Fig. — (In full size.) — The " perce-pierre" in action on a nearly spherical calculus of six or eight lines in diameter. The stone has already been once perforated, and another hole is about to be made. We can foresee that, in such a case as this, the " perce-pierre" is sufficient; for we may judge from the figure that, when the *perforator* shall have been put into action three or four times, the stone will probably be broken (provided it be well seized by the forceps, to which we, in some measure, contributed in the drawing), and only a few fragments will remain.

4th Fig.—(Full size.)—The "perce-pierre" is here represented in action on a nearly spherical stone of twelve or fourteen lines in diameter. The instrument is performing its first attack on the calculus, and the progress of the drill is marked in dotted lines. We see that, when the stone has acquired this size, the perforation only extends to two-thirds of its diameter.

5th Fig.—(Full size.)—The same spherical stone of from twelve to fourteen lines, attacked once by the "perce-pierre." The *solitary* hole is, as we see, only three lines and a half in diameter, and the conclusion which naturally follows is, that in order to reduce a stone of this size to fragments, a great number of holes will be required, which renders its [illegible] a tedious and fatiguing operation. Thus the "perce-pierre," in such cases as this, is insufficient, even when the calculus is as well seized as the figure represents, which is far from always being the case.

6th and 7th Figs.—(Full size.)—Action of the "perce-pierre" on a nearly spherical calculus of from fourteen to twenty-four lines in diameter. The drill has been brought into action *thirty* times to perforate the stone; but if we refer to the figures, which represent the two hemispheres of the calculus, we shall only find *nineteen* holes, more or less perfect. This deficiency is owing to the drill having *eleven* times made fruitless attacks on the stone, by entering into the holes which had been previously made, instead of forming eleven additional ones. If we carefully examine the 6th figure, we shall find that the *perforator* is about to commit a twelfth error.

From this we may reasonably conclude, that, in such cases, the "perce-pierre" is not only a very inefficient instrument, but that it is irrational and imprudent to employ it.

We might have gone further, and have shewn, by means of figures, the imperfections and *awkwardness* of the "perce-pierre" in the destruction of flat and oval stones, as also of certain fragments; but of this we trust our readers can, without our assistance, easily convince themselves.

TROIS BRANCHES A VIRGULE.

10th Fig.—(Reduced to one half.)—The "trois branches à virgule," closed.

11th Fig.—(Reduced to one half.)—The "trois branches à virgule," open.

17th Fig.—(Full size.)—The extremity of the "trois branches à virgule," closed.

18th Fig. — (Full size.) — The extremity of the "trois branches à virgule," open.

15th Fig.—(Full size.)—The perforating cylinder, seen on the side opposed to the "virgule."

16th Fig. — (Full size.) — The perforating cylinder represented on the side corresponding to the "virgule," which has attained its greatest degree of projection; the dotted lines shew in what manner it attained this development.

13th Fig.—(Full size.)—The action of the "trois branches à virgule" in the interior of a calculus of from twelve to fourteen lines in diameter. An excavation of eight or ten lines is already effected, and the "virgule" is performing the *movement of retreat*, which is on the point of being terminated by means of a peculiar manœuvre of the bow on the "mandrin à virgule." This movement will reduce the stone, in one single attack, to powder and several concave fragments, similar to those represented (fig. 14).

If we compare the 14th and 5th figures together—of which the latter shews the effect produced by one attack of the "perce-pierre" on a stone of from twelve to fourteen lines—we shall readily conceive the difference which exists between the action of these two instruments, and shall feel convinced that what the "perce-pierre" could not effect in several applications, the "virgule" accomplishes in a few minutes.

12th Fig.—Action of the "trois branches à virgule" on an

gral stone. This stone has already been attacked twice by the instrument, which has effected two considerable excavations. A third attack is about to be made, which will perhaps reduce the stone to fragments. This figure also represents the manner in which an oval calculus is seized by the three-branched instrument. It is evidently not very firmly maintained by the forceps, although there was a little assistance given on our part in placing it. We may certainly, by means of the "trois branchés à virgule," succeed in breaking such a stone; but it is just to observe that the action of the "virgules" in these cases is sufficiently imperfect to require that the attention should be directed to discover more suitable and effectual means.

SECOND PLATE.

This Plate represents the "Evideur à Forceps."

"EVIDEUR A FORCEPS."

1st Fig.—(Reduced to one half.)—The "pince-maîtresse" (principal forceps) closed, and without the "rappel."

6th Fig.—(Full size.)—Extremity of the "pince à forceps closed," shewing the grooved side of the "capuchon."

7th Fig.—(Full size.)—Extremity of the "pince à forceps" closed, shewing the opposite side of the "capuchon."

2d Fig.—(Reduced to one half.)—A silver stopple, destined to fill up the canal, through which an injection may be made into the bladder.

3d Fig.—(Reduced to one half.)—The "rappel" adapted to encircle the four buttons attached to the branches of the "pince-maîtresse," and to move them simultaneously when it is necessary.

4th Fig.—(Reduced to one half.)—The " rappel" encircling the buttons of the *principal forceps,* for the purpose of moving the branches altogether.

8th Fig.—(Reduced to one half.)—The " pince-servante" (assistant forceps) closed, and the *moveable stopple.*

9th Fig.—(Full size.)—Extremity of the " pince-servante" closed.

10th Fig.—(Reduced to one half.)—The " pince-servante" open, and the *moveable stopple.*

12th Fig.—(Full size.)—Extremity of the " pince-servante," open.

11th Fig.—(Reduced to one half.)—The " pince-maîtresse," the " rappel," and the " pince-servante" adjusted together. The " rappel" having been made to advance towards the external " pavillon," has caused the branches to project equally, and at once, from the tube, except the branch " à capuchon," which, by coming out through the hole of the " rappel," remained behind. If we draw the button of this branch towards the internal " pavillon," we make the " capuchon" come and place itself between two of the branches, which it expands, and thus leaves a wide opening for the stone to be received. The " pince-servante" is placed in the central canal of the " pince-maîtresse;" its three branches have hold of a large spherical calculus, which will be brought by the " servante" within the grasp of the principal forceps, as soon as the branch " à capuchon" shall be made to project as far as the other three. We also see that the " pince-servante," which in the figure is represented as an instrument destined to *seize,* becomes, when the branches are drawn together, an " indicateur," or an instrument to *indicate* when the calculus is well and firmly held by the forceps; and may also serve as a " repoussoir," or instrument adapted to give the stone a favourable position in the bladder for it to be readily seized by the forceps.

13th Fig.—(Reduced to one half.)—The " perforateur" (perforator).

14th Fig.—Blade of the perforator [illegible]

15th Fig.—Extremity of the perforator [illegible] full size.

16th Fig.—(Reduced to one half.)—The "[illegible]" ([illegible]), to which is attached the pulley belonging to it.

17th Fig.—(Full size.)—The extremity of the [illegible], with the blade inclined by the [illegible] progressive movement of [illegible]

18th Fig.—(Reduced to one half.)—The "percuteur" ([illegible]-rod), with the "curseur."

19th Fig.—The extremity of the [illegible] its full size.

20th and 21st Figs.—(Full size.)—[illegible] Forceps on a spherical Stone of [illegible] lines in diameter.

Let us begin by examining, in the 20th figure, the manner in which the calculus is seized and [illegible]. The branch "à capuchon" is, as we see, pushed out to a level with the other branches, and all four have taken firm hold on the stone, which is thus maintained immoveable, by means of these four points of support. This figure also represents, in dotted lines, the perforation effected in the calculus by the "perforateur;" it extends to about three-fourths of the antero-posterior diameter of the stone; the *perforator* having completed its action, will be withdrawn when the little blade is concealed in its mortise, and will be replaced by the *excavator*, the action of which is shewn by the 21st figure.

This figure represents the "évideur" about to terminate the *movement of retreat*. When the *excavator* was first introduced into the hole made by the *perforator*, it gradually enlarged this hole, and at last reduced the stone to a sort of shell. The *blade* of the "évideur" will shortly be stopped in its action by the opening formed at the entrance of the primitive perforation; and it will then have accomplished what it was intended for,

having reduced the stone to a thin, friable shell.* As soon as the rotatory movement of the "évideur" is impeded by the opening before alluded to, the *blade* must be immediately straightened, and the instrument withdrawn from the canal of the *principal forceps*.

22d and 23d Figs. — (Full size.) — A voluminous, spherical calculus, which has been excavated, and is cut in two to display the action of the apparatus "évideur à forceps."

If, after having examined the figure, we form a comparison between the action of the "perce-pierre" and that of the "évideur à forceps" on large spherical calculi, by comparing the 22d and 23d figures of the second plate with the 6th and 7th figures of the first plate, we shall, in the first place, readily perceive that the operation, as performed with the "évideur à forceps" would be in a much more advanced state than it would be with the "perce-pierre;" and to this we may add the reflection, that, to reduce the calculus to a shell, it was only *once* seized, and *once* acted upon, for a few minutes; whilst to cover the stone with perforations, as we see in the 6th and 7th figures of the first plate, it was necessary to seize the calculus thirty times, and act upon it as frequently.

We have made the stones represented in the plate as spherical as possible, in order to shew more completely the action of the "évideur à forceps." It is easy to conceive that, in proportion as the calculus becomes less spherical, the effect produced by the instrument is less satisfactory, although, even in these cases, the "évideur" acts much more effectually than any of the other instruments.

* Let it be remarked, that the stone from which the figure was drawn was fractured by the action of the "évideur à forceps;" but we glued the pieces together again, in order to shew, more correctly and completely, the action of the instrument.

THIRD PLATE.

This Plate represents the "Brise-Coque."

THE "BRISE-COQUE."

1st Fig.—(Reduced to one half.)—The "brise-coque" closed, seen in full.

12th Fig.—The extremity of the instrument closed, and seen in its full size.

2d Fig.—(Reduced to one half.)—The "brise-coque" closed, and seen sideways.

11th Fig. — (Full size.) — The extremity of the "brise-coque" closed, and placed in the same position.

3d Fig.—(Reduced to one half.) —The "brise-coque" seen in full, with the branches expanded, and consequently with the lever (*g*) inclined.

10th Fig.—The extremity of the "brise-coque" is represented in its full size, with the branches expanded.

4th Fig.—(Reduced to one half.)—The "brise-coque" in action on a flat calculus.

9th Fig. — (Full size.) — The extremity of the "brise-coque," shewing that, when the branches are drawn together to seize a stone or fragment, they only unite sufficiently to seize these bodies, without approaching near enough together to expose the parietes of the organ to any liability of being compressed between them.

8th Fig. — (Full size.) — Action of the "brise-coque" on concave fragments, produced by the *excavating instruments.* It is evident that the branches, being powerfully drawn together, must necessarily crush the fragment placed between them, and

this is what always takes place, whatever be the hardness of the fragment.

5th Fig.—(Full size.)—The "brise-coque" in action on an oval stone of ten or twelve lines in its longest diameter. In one or two more inclinations of the lever, the calculus will be reduced to fragments and powder.

6th Fig.—Action of the "brise-coque" on an oval calculus of ten or twelve lines in its smallest diameter. We see that the branches take their hold much nearer the edge of the stone than would be the case if it were flat, as in the 7th figure. The crushing will not, therefore, be so completely effected as in the cases represented in the 5th and 7th figures; although all that portion of stone interposed between the branches will inevitably be reduced to powder and fragments, and the fracture will very likely extend, by means of the irradiating splits resulting from the powerful pressure of the branches, to a considerable portion of the stone beyond the point where it is seized. This is, in most cases, the result of the action of the "brise-coque" on calculi of this shape and size, however hard they may be; but we must at the same time remark, that these are the limits which must be placed to the power of this instrument; and that, although we may, by its means, destroy a calculus of this size, we ought to admit that, whenever it attains a thickness of eight or ten lines, an instrument even more powerful than the "brise-coque" is required.

From this reflection we may conclude that, although it is possible to destroy large oval calculi with the "trois branches à virgule" and "brise-coque," these means are not, in some cases, and, in certain respects, quite satisfactory in their action.

FOURTH PLATE.

This Plate represents the Accessory Instruments.

ACCESSORY INSTRUMENTS.

1st Fig.—(Full size.)—The *recto-curvilinear sound,* shewing exactly its curve, which is equivalent to *the quarter of the circumference of a circle, described with a radius of an inch and a half.*

2d and 3d Figs.—(Full size.)—Pieces of sound, of different lengths, which can be screwed to the end of the *recto-curvilinear sound,* instead of the piece which terminates it in the figure, and thus diminish the curve, if circumstances should require it,

4th Figure.—(Reduced to one half.)—*Surgical syringe,* which is employed to inject the bladder.

5th Fig.—(Reduced to one half.)—The *drill-bow.*

6th Fig.—(Full size.)—The *drill-driver,* or *hand-vice.*

8th Fig.—(Full size.)—The *turnscrew,* to tighten the buttons, which render the branches of the "évideur à forceps" moveable or immoveable.

9th Fig.—(Full size.)—A *syphon,* or *gum-elastic pipe,* by means of which we inject water into the bladder through the instruments themselves.

7th Fig.—(Full size.)—*Conical sound.*

FIFTH PLATE.

This Plate represents the different means adapted to support the Patient and the Instruments.

1st Fig.—(Reduced to one-third.)—That part of the "chevalet" called the "support."

2d Fig.—(Reduced to one-third.)—That part of the "chevalet" called the "repoussoir."

3d Fig. — (Reduced to one-third.) — The "chevalet" in entire. The "repoussoir" and the "support" are adjusted together; a three-branched instrument is fixed in the mortise of the "support," and the extremity of the drill is placed in the tube found in the little stem of the "repoussoir."

4th Fig.—(Reduced to one-eighth.)—This figure represents the *rectangular bed*, resting on the angle existing between the longest and shortest sides of the triangle presented by the three pieces of wood which form the sides of the bed. The dotted lines shew the position in which the bed is placed when it is made to rest upon the hypothenuse, or longest side of the triangle. The patient's pelvis, in the inclined position, forms with the horizon an angle of forty-five degrees, although the trunk and the head still retain the *horizontal posture*.

5th Fig.—(Reduced to one-third.)—The "fixed support," represented in full, with an instrument placed in its mortise, and retained there by means of the pressure of the screw existing at the side of this mortise.

6th Fig.—(Reduced to one-third.)—The "fixed support," placed in such a manner as to display the interior of the

mortise, and shew how the screw acts to render the instrument immoveable.

By referring to the 4th figure once more, we shall perceive in what manner the "fixed support" plays in the mortise found in the piece (D. D.) of the bed, and also how it may be rendered fixed. We see that, when the screw-handle (4) is in the position represented by the drawn lines of the figure, the "support" falls through the mortise as far as its superior part, by which it is maintained; when, on the contrary, the handle is placed in the position represented by the dotted lines, the "support" is then fixed at any height, as is equally seen by the dotted lines in the figure. The instrument is then placed in the mortise, as has been before explained.

We may form an idea of the position in which the instrument is placed as regards the bladder, if we fancy to ourselves the patient's pelvis placed quite on the front of the mattress, his head and shoulders supported by the pillow, and his feet resting in the sandals.

7th Fig.—(Reduced to one-sixth.)—A wadded belt, destined to support the patient's shoulders, and hinder him from sliding backwards when it is found necessary to elevate the pelvis to an angle of forty-five degrees, by inclining the bed.*

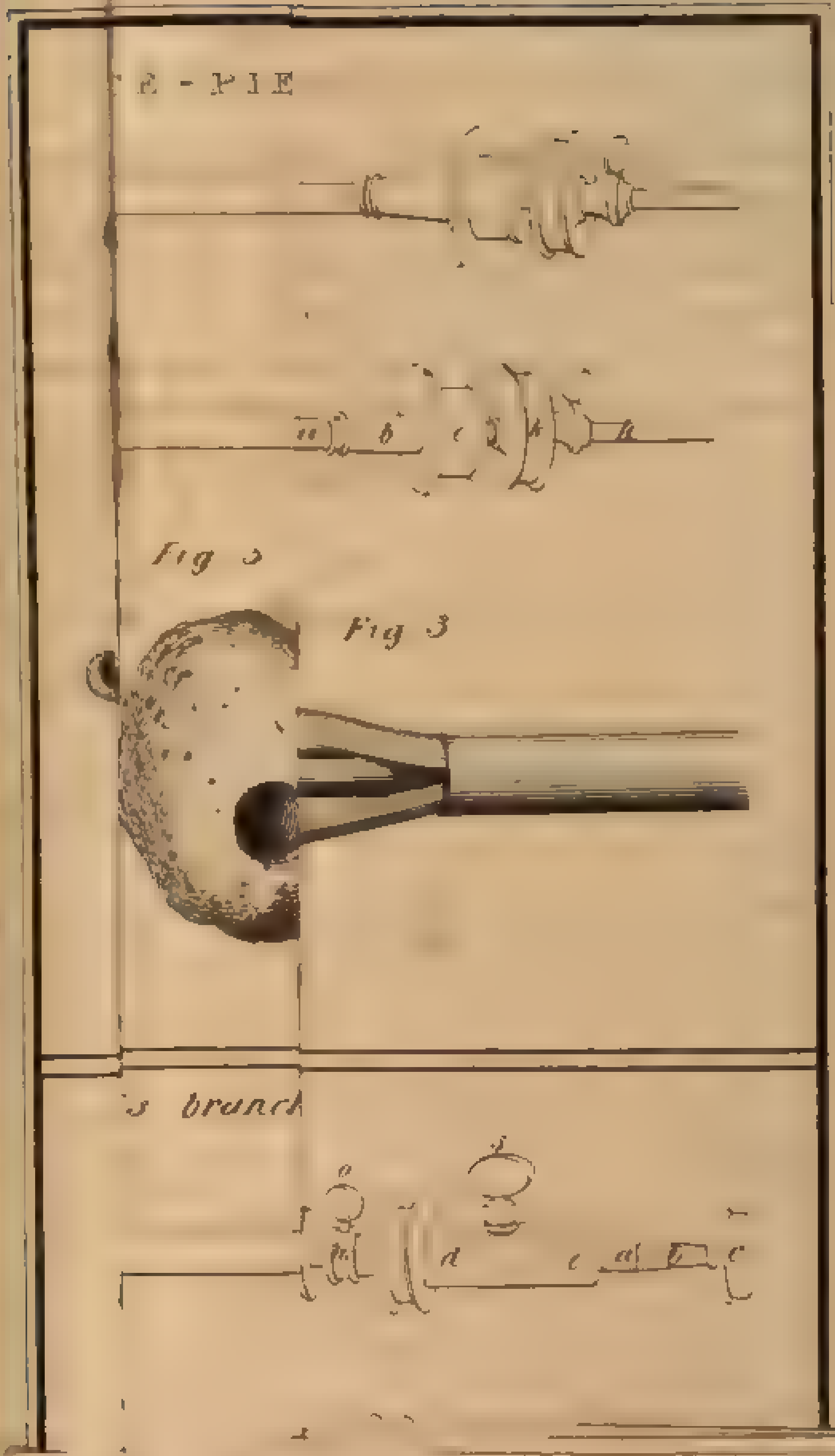
---

* The plates represent the lithotritic instruments of the diameter which is usually required; but it is absolutely necessary that they should be of different diameters, according to the capacity of the urethra: they should consequently vary from two lines to four and a half.

FINIS.

LONDON:
HENRY BAYLIS, JOHNSON'S-COURT, FLEET-STREET.

PLATE I.



FOURTH PLATE.

This Plate represents the Accessory Instruments.

ACCESSORY INSTRUMENTS.

1st Fig.—(Full size.)—The *recto-curvilinear sound*, shewing exactly its curve, which is equivalent to *the quarter of the circumference of a circle, described with a radius of an inch and a half.*

2d and 3d Figs.—(Full size.)—Pieces of sound, of different lengths, which can be screwed to the end of the *recto-curvilinear sound*, instead of the piece which terminates it in the figure, and thus diminish the curve, if circumstances should require it,

4th Figure.—(Reduced to one half.)— *Surgical syringe*, which is employed to inject the bladder.

5th Fig.—(Reduced to one half.)—The *drill-bow.*

6th Fig.—(Full size.)—The *drill-driver*, or *hand-vice.*

8th Fig.—(Full size.)—The *turnscrew*, to tighten the buttons, which render the branches of the " évideur à forceps" moveable or immoveable.

9th Fig.—(Full size.)—A *syphon*, or *gum-elastic pipe*, by means of which we inject water into the bladder through the instruments themselves.

7th Fig.—(Full size.)—*Conical sound.*

PLATE V

Fig 6

MOYES Rectangle.